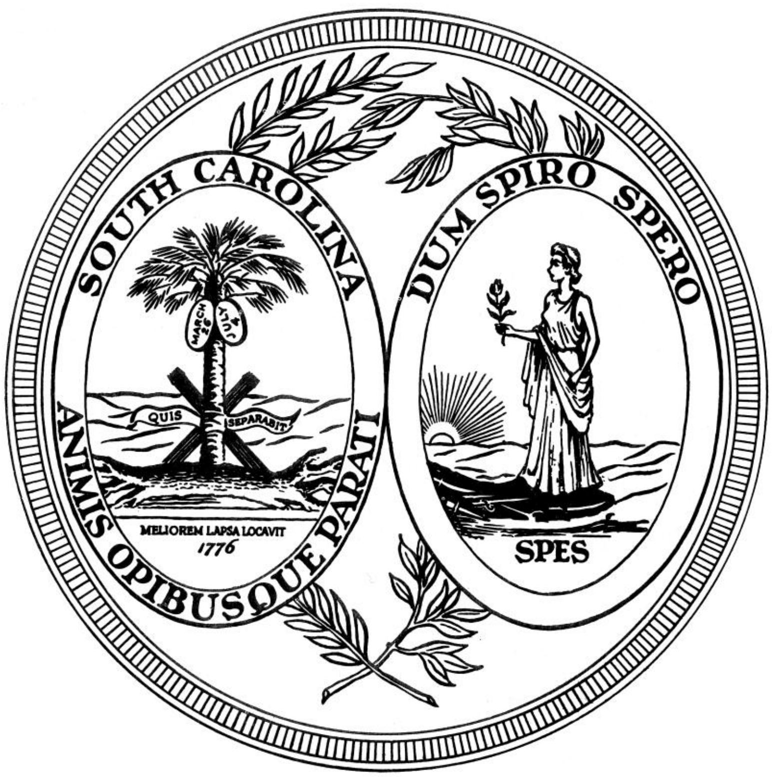
South Carolina Hazard Mitigation Plan



October 2013
Update

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SOUTH CAROLINA HAZARD MITIGATION PLAN 2013

EXECUTIVE SUMMARY

A. BACKGROUND

The Disaster Mitigation Act of 2000, an amendment of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288) of 1988, set forth the mission to establish a national disaster hazard mitigation program to:

> *(1) reduce the loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters; and*
>
> *(2) provide a source of pre-disaster hazard mitigation funding that will assist States and local governments (including Indian tribes) in implementing effective hazard mitigation measures that are designed to ensure the continued functionality of critical services and facilities after a natural disaster.*

This Act also outlines the mandate for states and local communities to have an approved mitigation plan in order to receive pre- and post-disaster hazard mitigation funding.

On October 22, 1999, Executive Order 99-60 was signed by Governor Jim Hodges, establishing the South Carolina Hazard Mitigation Interagency Coordinating Committee (ICC). The ICC's purpose is to assist the Governor's Office and the General Assembly in identifying the hazard mitigation issues and opportunities facing the state for the purpose of developing comprehensive hazard mitigation strategies, policies, and reports on hazard mitigation issues, ensuring state agencies and local governments collaborate, develop, and execute sustainable hazard mitigation actions, and coordinate and support agency efforts in obtaining and administering federal and other mitigation grants to reduce the risks posed by all hazards to the State of South Carolina. In accordance with these Acts, South Carolina has updated the State Hazard Mitigation Plan to meet all federal guidelines set forth for mitigation planning, risk assessment, and grant program management.

B. MISSION/PURPOSE

This plan outlines the state's strategy for all natural hazard mitigation goals, actions, and initiatives. The South Carolina Hazard Mitigation Plan is the result of the systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards present in the State of South Carolina and includes the actions needed to minimize future vulnerability to those hazards. It sets forth the policies, procedures, and philosophies that are used to establish and implement hazard mitigation activities within the state. Effective and consistent implementation of this plan is crucial to the hazard mitigation program and the state's efforts to reduce or eliminate the threat of future disasters. This State Hazard Mitigation Plan, formally adopted in October 2004, incorporates all changes associated with the implementation of the Federal/State hazard mitigation program, including the applicable sections of the Disaster Mitigation Act of 2000. Overall administration of the hazard mitigation program shall be the responsibility of the South Carolina State Emergency Management Division.

C. STATEWIDE RISK ASSESSMENT FINDINGS

The State is vulnerable to a multitude of natural and manmade hazards. The following hazards have the potential to affect the citizens and property of South Carolina:

- Earthquakes
- Hurricanes
- Coastal Issues
- Floods
- Thunderstorms
- Tornadoes
- Lightning
- Hail
- Sea Level Rise
- Sink Holes
- Drought
- Winter Weather
- Wildfire
- Landslides
- Extreme Heat
- Nuclear Facilities
- Terrorism
- Pandemic and other disease outbreak

Not all hazards are created equal. They can impact different regions of the state, greatly differ in physical size, and cause different types of social, economic, and infrastructural damage. **Figure 1** below depicts the relationship between hazard probability (likelihood) and consequence (potential losses). Hazard events such as hurricanes and earthquakes can have large consequences, but they do not happen as frequently as severe storms, wildfires, lightning, and hail. Hazards that occur regularly and have the potential to cause a great amount of damage are the hazards for which the State spends the most time planning and preparing. The top right quadrant of the figure depicts those particular hazards. The hazards in the top left quadrant are also of great importance. These hazards have a high consequence but low probability of occurrence.

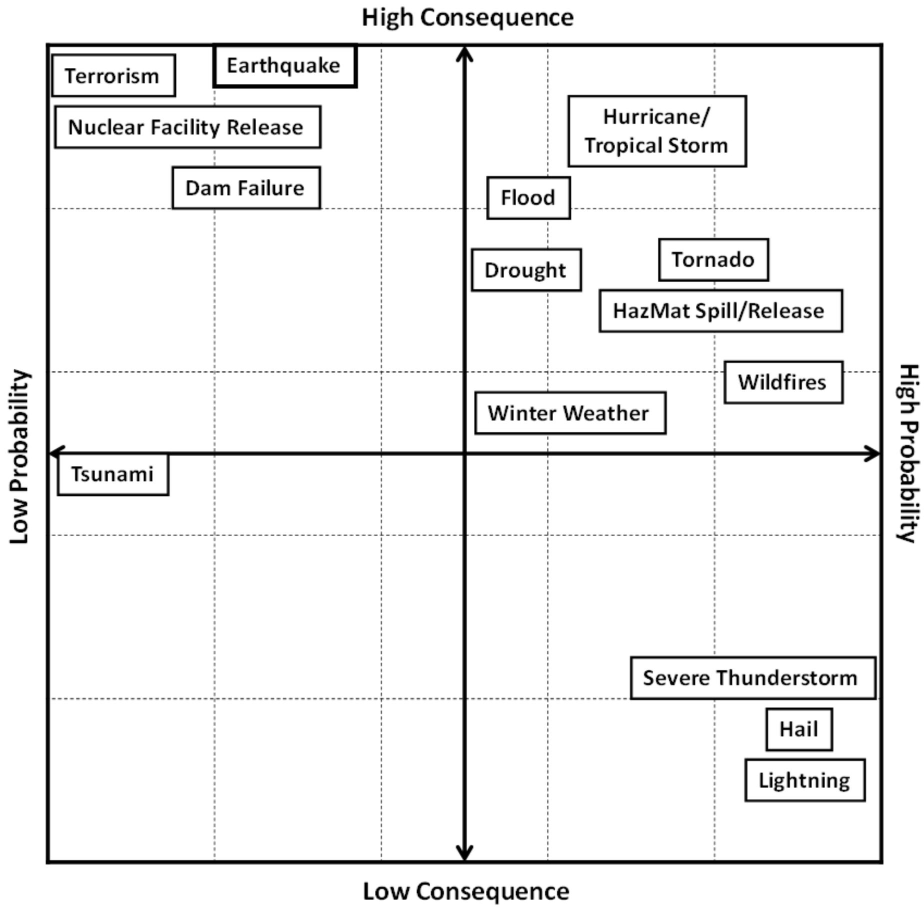


FIGURE 1—PROBABILITY VS. CONSEQUENCE
Source: SCEMD Emergency Operations Plan

The risk analysis in Section IV analyzes all hazards that impact the State. The results indicate that there are regional differences in natural hazard risk and vulnerability. Wildfires are our most frequent hazard experienced in the state, with over 101,000 recorded events. Coastal events such as erosion are our least common hazard, which is likely due to a lack of historically collected data and relatively small portion of properties affected. Annually, the State experiences the greatest losses from winter storms, drought, tornadoes, coastal events, and severe storms. Although they occur infrequently compared to other hazard types, hurricanes and earthquakes have the greatest potential to be disastrous to South Carolina. A singular earthquake or major hurricane could cost over $20 billion in losses, take countless lives, and require years of recovery.

At the local level, Charleston County is the most hazardous county in the State. The county is vulnerable to all hazards and is located adjacent to the largest earthquake hazard on the East Coast. Spartanburg, Greenville, Berkeley, and Orangeburg Counties round out the top five most hazardous counties. These five counties have incurred over $87 million in hazard event losses since 1960, accounting for 32% of the state's total hazard losses. McCormick County is the least hazardous county in South Carolina, along with Edgefield, Saluda, Calhoun, and Allendale Counties. Their distance from coastal areas and winter weather-prone upstate, make them less vulnerable to the effects of natural hazards.

South Carolina has developed an array of hazard specific disaster plans that address how the State intends to protect the life and safety of its citizens; ensure continued delivery of critical and essential functions and services; and reduce loss and damage to its facilities and infrastructure system. All hazard or functional plans work in concert with the SC Emergency Operations Plan. This base plan establishes a framework for an effective system of comprehensive emergency management for addressing the various types of emergencies that are likely to occur, from local emergencies with minor impact to major or catastrophic disasters.

D. MITIGATION GOALS

Based on the findings of the Risk Assessment, the list of mitigation goals has been updated and modified to guide both the day-to-day operations and the long-term approach taken by the State of South Carolina to reduce the impacts of hazards. Goals represent broad statements that are achieved through the implementation of more specific, action-oriented policies or projects. Goals provide the framework for achieving the intent of the Plan.

Goal #1: Implement policies and projects designed to reduce or eliminate the impacts of hazards on people and property.

Goal #2: Obtain resources necessary to reduce the impact of hazards on people and property.

Goal #3: Enhance training, education, and outreach efforts focusing on the effects of hazards, importance of mitigation, and ways to increase resiliency.

Goal #4: Collect and utilize data, including conducting necessary studies and analyses, to improve policymaking and identify appropriate mitigation projects.

Goal #5: Improve interagency coordination and planning to reduce the impact of hazards on people and property.

Goal #6: Enhance compliance capabilities in order to reduce the impacts of hazards on people and property.

Goal #7: Enhance and encourage the use of natural resource protection measures as a means to reduce the impacts of hazards on people and property.

E. INTERAGENCY COORDINATION AND INITIATIVES

The ICC is composed of four State Agencies: the South Carolina Emergency Management Division (SCEMD), Department of Insurance (SCDOI), Department of Natural Resources (SCDNR), and Department of Health and Environmental Control (SCDHEC). These four agencies meet on a quarterly basis to discuss the state of mitigation in South Carolina, update the Plan, amend priorities and goals as we adjust to changing budgets and personnel constraints, and prioritize mitigation funding and actions pre- and post-disaster. Each agency participates in mitigation initiatives across the state to serve and protect the life and property of South Carolina residents.

SCEMD is responsible for the application, award, grant management, and closeout of two mitigation grants: the Pre-Disaster Mitigation (PDM) grant program and the Hazard Mitigation Grant Program (HMGP). Both grants offer federal mitigation assistance through the Federal Emergency Management Agency (FEMA) to do plans and projects to protect against all natural hazards. SCEMD is also the lead agency on all-hazard risk assessment, mitigation planning at the state and local level, and post-disaster mitigation activities.

The SC Department of Insurance is responsible for implementing the mandates established in The Omnibus Coastal Property Insurance Reform Act of 2007. They established the nationally recognized SC Safe Home mitigation grant program to retrofit coastal homes and assist in lowering coastal property insurance cost for homeowners.

The South Carolina Department of Natural Resources is responsible for the application, award, grant management, and closeout of the Flood Mitigation Assistance grant program. This grant program offers federal mitigation assistance through the FEMA to update the flood mitigation portion of hazard mitigation plans and projects to protect against flooding. SCDNR is also the lead agency on the update and maintenance of the statewide Digital Flood Insurance Rate Maps.

The South Carolina Department of Health and Environmental Control conducts mitigation planning and activities by ensuring that facilities, businesses, and water and air quality businesses and agencies meet the minimum standards as established in regulations. Specifically, the dam infrastructure is monitored by SCDHEC staff and dam safety is an area of mitigation concern. The agency also implements surveillance measures to monitor, advise and protect the public and healthcare providers in the case of bioterrorism or disease outbreaks.

The SCDHEC Office of Ocean and Coastal Resource Management (OCRM) is directed by the SC Coastal Zone Management Act (1977) "…to provide for the protection and enhancement of the State's coastal resources." A component of protecting the State's coastal resources is mitigating disasters. The Department promotes disaster mitigation through: 1) Critical Area permitting, 2) local beach management plans, and 3) renourishment funding assistance.

F. CONCLUSION

The ICC has reviewed and updated the 2010 State Hazard Mitigation Plan. This plan includes an improved risk assessment, revised state mitigation goals, updated state mitigation actions, and a new organization to reduce redundancy. The finished product is a comprehensive document based on scientific analysis and professional expertise in the fields of emergency management, natural hazards, code enforcement and infrastructure enhancement. The risk assessment clearly illustrates that South Carolina is at risk to numerous natural, technological, and man-made hazards. As a state, we must be knowledgeable of our vulnerabilities to ensure that we can protect our citizens and infrastructure. Mitigation is the most sustainable and cost efficient method to prevent future losses.

The common thread throughout the plan is collaboration. The State of South Carolina believes that mitigation is most successful in a collaborative environment where goals and resources are shared, local initiatives are prioritized, and benefits are felt statewide. Each state agency has shown their dedication to mitigation through their participation in the ICC or the State Hazard Mitigation Team.

Like other states throughout the country, South Carolina has been severely affected by a dismal economy, triggering the ICC to become more fiscally practical in prioritizing its mitigation goals. These goals reflect feasible and realistic strategies that our State and Local partners can achieve to protect the lives and property of its citizens. The ability for the State to redevelop and change mitigation priorities in congruence with the economy indicates a flexible mitigation strategy.

This plan is designed to guide the State in fulfilling a state hazard mitigation mission and is structured to serve as a basis for post-disaster hazard mitigation efforts. As required by the DMA 2000, this plan will be updated and submitted to FEMA for review and approval in 2016.

I. INTRODUCTION

Natural hazards, including floods, hurricanes, earthquakes and severe winter storms, are a part of the world around us. Their occurrence is natural and inevitable, and there is little we can do to control their force and intensity. The threat of the occurrence of manmade disaster is an area of concern for Emergency Management professionals. The State of South Carolina faces a variety of these hazards, each of which is discussed in Section 4 *Hazard Assessment*.

Hazard mitigation involves the use of specific measures to reduce the impact of hazards on people and the built environment. Measures may include both structural and non-structural techniques, such as protecting buildings and infrastructure from the forces of nature or wise floodplain management practices. Actions may be taken to protect both existing and/or future development. It is widely accepted that the most effective mitigation measures are implemented before an event at the local government level, where decisions on the regulation and control of development are ultimately made.

A. ADOPTION BY THE STATE

Requirement 44 CFR §201.4(c)(6): The plan must be formally adopted by the State prior to submittal to [FEMA] for final review and approval.

The South Carolina Hazard Mitigation Plan is the result of the systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards present in the State of South Carolina and includes the actions needed to minimize future vulnerability to those hazards. It sets forth the policies, procedures, and philosophies that are used to establish and implement hazard mitigation activities within the state. Effective and consistent implementation of this plan is crucial to the hazard mitigation program and the state's efforts to reduce or eliminate the threat of future disasters. Overall administration of the hazard mitigation program shall be the responsibility of the South Carolina Emergency Management Division. The State will officially adopt the 2013 State Hazard Mitigation Plan update upon FEMA review and receipt of approval pending adoption (APA) status. The resolution will be placed in Appendix D. A draft execution letter is currently included.

B. PURPOSE

The purpose of this Plan is to set forth a consistent and unified statewide vision for mitigation to protect the citizens and property of South Carolina. This plan is designed to be both strategic—guiding the day-to-day decisions of state officials—as well as comprehensive in nature—providing a long-term vision of how the state will address hazards over time. In addition to the identification and prioritization of possible projects, emphasis has been placed on the use of broad policy goals to assist South Carolina to become less vulnerable to the damaging forces of nature, while improving the economic, social, and environmental health of the state. The concept of multi-objective planning is emphasized throughout this document, identifying ways to link hazard mitigation policies and programs with complimentary state goals related to housing, economic development, recreational opportunities, transportation improvements, environmental quality, and public health and safety. The following ideas describe the South Carolina mission for mitigation:

1. Protect life, safety and property by reducing the potential for future damages and economic losses that result from hazards;
2. Meet the requirements of the Disaster Mitigation Act of 2000, and therefore qualify for the following programs: Fire Management Assistance Grants, Public Assistance Program, Hazard Mitigation Grant Program, and Pre-Disaster Mitigation Program;
3. Speed recovery and redevelopment following future disaster events;
4. Enhance the capability of all counties and municipalities to address identified hazards by providing technical support and training;
5. Establish an effective forum for state agencies and statewide organizations to discuss and coordinate existing and future plans, programs, data, rules and regulations and expertise addressing hazard-related issues;
6. Increase the effectiveness and efficiency of hazard mitigation programs and projects sponsored, financed, or managed by state agencies or statewide organizations; and
7. Demonstrate a firm commitment to state and local hazard mitigation planning.

C. OVERVIEW OF GOALS

The following goals have been identified by the ICC to provide direction for future mitigation funding and actions in South Carolina:

Goal #1: Implement policies and projects designed to reduce or eliminate the impacts of hazards on people and property.

Goal #2: Obtain resources necessary to reduce the impact of hazards on people and property.

Goal #3: Enhance training, education, and outreach efforts focusing on the effects of hazards, importance of mitigation, and ways to increase resiliency.

Goal #4: Collect and utilize data, including conducting necessary studies and analyses, to improve policymaking and identify appropriate mitigation projects.

Goal #5: Improve interagency coordination and planning to reduce the impact of hazards on people and property.

Goal #6: Enhance compliance capabilities in order to reduce the impacts of hazards on people and property.

Goal #7: Enhance and encourage the use of natural resource protection measures as a means to reduce the impacts of hazards on people and property.

D. AUTHORITY

This plan will be adopted by the State of South Carolina under the authority and powers granted to the State in General Statutes. The following federal and state authorities shall guide the plan:

1. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288) as amended by the Disaster Mitigation Act of 2000 (Public Law 106-390 – October 30, 2000).
2. Title 44 of the Code of Federal Regulations.
3. The Housing and Community Development Act of 1974, as amended, and the US Department of Housing and Urban Development's Consolidated Plan regulations in Title 24, parts 91 and 570 of the Code of Federal Regulations.
4. South Carolina Code of Laws Ann., 25-1-420 through 25-1-460.
5. Regulation 58-1, Local Government Management Standards, South Carolina Code of Regulations
6. Regulation 58-101, State Government Management Standards, South Carolina Code of Regulations.
7. Executive Order No. 99-11 of the Governor of South Carolina.
8. Title 6, Chapter 9 of South Carolina Code of Laws, as amended.
9. The South Carolina Coastal Zone Management Act, as amended.
10. Biggert-Waters Flood Insurance Reform Act of 2012.

E. PLAN UPDATE REQUIREMENT

Requirement 44 CFR §201.4(c)(7): The plan must include assurances that the State will continue to comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with §13.11(c). The State will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in §13.11(d).

Following the passage of the Disaster Mitigation Act of 2000, states and local governments are now required to develop and adopt a hazard mitigation plan in order to remain eligible for FEMA mitigation grant funding. Communities with an adopted plan will become "pre-positioned" and potentially more apt to receive available mitigation funds. Since mitigation dollars flow from FEMA and through the state to local governments, it is incumbent on states to develop a State Hazard Mitigation Plan in order to be eligible to receive FEMA pre or post-disaster mitigation funding. This plan is designed to meet the requirements of the Disaster Mitigation Act of 2000 (DMA 2000) and the South Carolina Emergency Management Division. This plan is also designed to seek out other federal and state funding beyond those available through FEMA to accomplish desired objectives. Additionally, the State will continue to comply with all other applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with §13.11(c).

The SCEMD Mitigation Section will review and update the plan annually, or if hazard mitigation regulations or guidelines change, the review will be completed as needed. Additionally, the plan update will be submitted to FEMA Region IV following a Presidential disaster declaration to include new disaster information and modifications to the State's priorities. The final State of South Carolina Hazard Mitigation Plan will be submitted to the ICC and the State Emergency Management Division Director, as the authorized representative of the Governor, for final approval every three years. Once the ICC and Director concur with the updates, the plan will be sent to FEMA Region IV for review. Upon FEMA approval of the plan, a letter with the Director's signature will declare the document as officially adopted by the State. The document will then be forwarded to FEMA Region IV to finalize plan approval.

F. EMERGENCY MANAGEMENT ACCREDITATION PROGRAM (EMAP)

The Emergency Management Accreditation Program (EMAP) is the voluntary assessment and accreditation process for state and local government programs responsible for coordinating prevention, mitigation, preparedness, response, and recovery activities for natural and human-caused disasters. Accreditation is based on compliance with national standards, the EMAP Standard.

As of October 2008 SCEMD has become EMAP accredited. SCEMD is currently undergoing its 2013 reaccreditation process. All elements of the State Emergency Management program have been developed, or updated, to meet these standards. This includes the State Hazard Mitigation Plan. Therefore, this plan was designed to meet the following EMAP standards that apply to hazard mitigation plans (EMAP Standard 4.3: Hazard Identification, Risk Assessment and Consequence Analysis; and 4.4: Hazard Mitigation). Notations are made throughout this plan to indicate where EMAP standards have been addressed.

II. PLANNING PROCESS

A. OVERVIEW OF HAZARD MITIGATION PLANNING

Mitigation planning is a critical component for a successful emergency management program. A comprehensive mitigation plan forms the foundation for a community's long-term strategy to reduce disaster losses, protect lives and property, and break the repetitive cycle of disaster damages, injuries and loss of life. A core assumption of hazard mitigation is that a pre-disaster investment can significantly reduce the demand for post-disaster assistance. Further, the adoption of mitigation actions enables local residents, businesses and industries to more quickly recover from a disaster, getting the economy back on track sooner and with less interruption. Mitigation planning is an integral step to becoming a less vulnerable, resilient state, capable of bouncing back after a natural hazard event.

The benefits of mitigation planning go beyond reducing hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, maintaining environmental health, and enhancing recreational opportunities. It creates a framework for risk-based decision making that will continue to not only protect the current infrastructure and populations, but prevent future generations and development from being significantly impacted by natural hazards. We cannot control nature, but we can control how we grow physically, economically, and socially in the future.

B. PREPARATION OF THE PLAN

This plan identifies a multitude of natural and non-natural hazards and considers ways to reduce vulnerability in South Carolina. It encompasses a range of life and property-saving hazard mitigation initiatives in the categories of mitigation coordination, structural and non-structural retrofitting, floodplain management, public safety, and emergency preparedness. Both short-term and long-term hazard mitigation measures are identified in order to help all state and local agencies allocate resources in a responsible manner to provide for the public safety, public health, and general welfare of all the people in South Carolina.

This plan has taken into account many years of mitigation experience, and a variety of mitigation projects, from South Carolina and other states. It has taken advantage of the collective mitigation knowledge of many State, Federal, and Local officials, as well as representatives from both the public and private sectors, and is designed as one component to help safeguard the citizens of the State of South Carolina. As such, it should significantly contribute to the mitigation of future South Carolina disasters.

The State of South Carolina utilized the process required by the Federal Emergency Management Agency to develop this plan. The hazard mitigation planning process included the following steps, listed in the order in which they were updated:

1. Executive Summary
2. Planning Process;
3. Capability Assessment
4. Community Profile;
5. Risk Assessment
6. Mitigation Strategy; and
7. Plan Maintenance Procedures.

The plan update began immediately after the 2010 plan was adopted by South Carolina and approved by FEMA on October 19, 2010. The ICC met each quarter starting in January 2011 to discuss the schedule of updates, revisions to the old plan, new mitigation initiatives for inclusion in the update, modifications to mitigation goals and strategies, and innovative risk assessment methodologies to be utilized in the update. All members of the ICC participated in the quarterly conference calls and meetings and provided agency specific input for each updated section. The highlight of the plan update process was the annual meeting of the State Hazard Mitigation Team. The meeting, or more accurately titled the State Government Mitigation Actions Workshop, is a time for all state agencies to gather to comment on the mitigation planning process and provide mitigation actions for inclusion in the final plan. The Workshop sign-in sheet and all ICC meeting agendas and minutes can be found in Appendix A.

While all sections of the plan were updated to reflect current mitigation information and planning priorities, special attention was focused on improving the risk assessment, updating state agency mitigation actions, and realigning the State Mitigation Goals to reflect current state priorities. To document all changes, a subsection has been included in each section of the plan that summarizes the information changed in this updated plan. Another major adjustment in this plan is the use of the 2010 Census data. The state saw significant growth, especially along the coast. This improved data is presented in the State Profile and Hazard Assessment sections of this plan.

C. STATE & LOCAL COORDINATION

Since the enactment of the Disaster Mitigation Act of 2000, every South Carolina County has submitted a FEMA-approved Local Hazard Mitigation Plan (LHMP). The hazard identification, risk analyses, and vulnerability assessments provide estimates of potential property losses throughout the State. Based on the information in these assessments, each county identifies a list of hazard mitigation measures and provides an action plan on their implementation.

In accordance with federal regulations, Local Hazard Mitigation Plans must be reviewed and updated every five years to be eligible for pre- and post-disaster federal mitigation funding. The State provides technical assistance and guidance to the local community prior to the plan update and submittal to FEMA. Upon approval by FEMA, the Plan must be adopted by each participating jurisdiction. Any governing body choosing not to adopt the Plan will be ineligible to apply directly for disaster assistance. In some instances, eligible county governments may apply for mitigation funding on the behalf of their non-adopting jurisdictions.

There are 46 counties, all of which have a multi-jurisdictional, multi-hazard LHMP in South Carolina. These local plans are at different stages in the update and renewal process, depending upon when their initial LHMP was approved.

Since 2007, the SCEMD and SCDNR have assisted local jurisdiction in completing their approved mitigation plans by assisting them in acquiring Hazard Mitigation Assistance (HMA) funding to prepare and write their plans. **Table 2.1** provides the source and year of funding, the type of plan, lists the jurisdictions, and funding amounts.

TABLE 2.1—HMA FUNDED MITIGATION PLANS

Funding Source	Plan Type	Plan Name	Amount	Comments
PDM-2007	Single Jurisdiction	City of Greer Single-Jurisdiction Plan	$30,000.00	
PDM-2007	Single Jurisdiction	Greenville City Single-Jurisdiction Plan	$61,452.00	
PDM-2007	Single Jurisdiction	City of Simpsonville Single-Jurisdiction Plan	$27,000.00	
PDM-2007	Single Jurisdiction	Town of Santee Single-Jurisdiction Plan	$19,111.00	
PDM-2009	Regional COG	Berkeley-Charleston-Dorchester COG Multijurisdictional Mitigation Plan	$60,000.00	Counties of Berkeley and Dorchester
PDM-2009	Regional COG	Central Midlands COG Multijurisdictional Plan	$113,584.70	Counties of Fairfield, Richland, Lexington, Newberry
PDM-2009	Regional COG	Lower Savannah COG Multijurisdictional Mitigation Plan	$75,000.00	Counties of Beaufort, Colleton, Hampton, Jasper
PDM-2009	Regional COG	Upper Savannah COG Multijurisdictional Mitigation Plan	$60,000.00	Counties of Abbeville, Edgefield, Greenwood, Laurens, McCormick, Saluda
PDM-2009	Regional COG	Lowcountry COG Multijurisdictional Mitigation Plan	$38,998.70	Counties of Colleton, Hampton, Jasper
PDM-2009	DRU	University of South Carolina DRU Plan	$426,455.50	Main Campus and 7 satellite campuses
PDM-2010	DRU	MUSC-Disaster Resistant University Plan	$71,268.00	
PDM-2010	Multi-Jurisdiction	Spartanburg County Hazard Mitigation Plan	$49,585.00	
PDM-2012	Tribal	Catawba Indian Nation Pre-Disaster Mitigation Plan	$52,594.00	

In addition to funding mitigation plans, SCEMD has worked with local communities, tribal nations, and universities to obtain PDM funds to implement projects. Since the 2010 SHMP, PDM grants were awarded on a competitive basis for the projects referenced in **Table 2.2.**

Table 2.2 Funded Pre-Disaster Mitigation Projects

PROJECT NAME	GRANT NUMBER	FEDERAL FUNDS
Chester County, SC Raxter Road Bridge Construction	PDMC-PJ-04-SC-2010-019	$577,500
MUSC Institute of Psychiatry Generator Relocation	PDMC-PJ-04-SC-2011-010	$1,561,953
MUSC Hospital Fuel Pump Relocation	PDMC-PJ-04-SC-2011-004	$3,000,000

D. PLAN & PROGRAM INTEGRATION

The State of South Carolina is fully committed to an effective and comprehensive mitigation program. The Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and mitigation planning are all the direct responsibility of SCEMD. In order for these programs to achieve their full potential, multiple state activities should compliment appropriate mitigation goals and strategies. The best way to accomplish that task is to ensure that mitigation goals and initiatives are integrated to the maximum extent into all possible planning activities for Federal, State and local governments. Over the years, the works of these various entities have been incorporated into the State Hazard Mitigation Plan and the planning of other state agencies.

The SHMP is not a stand-alone plan. The ICC incorporated the ideas and principles of a multitude of statewide and regional plans into the development of this plan. For example, this mitigation plan supports the goals established by the South Carolina Department of Insurance SC Safe Home Program, which promotes the strengthening of homes against damaging effects of high winds from hurricanes and severe storms. This plan also builds on the analysis and recommendations made in DHEC's South Carolina Comprehensive Beach Management Plan. The flood mitigation and mapping practices found in SCDNR's Flood Mitigation Program are integrated throughout. Natural hazard data and analysis from existing SCEMD state plans (i.e. SC Hurricane Plan, SC Earthquake Plan, etc) were incorporated into this update as well. In addition, it is important to note that the SHMP risk analysis and mitigation strategy is used in other state and local plans, reinforcing the goals of the SHMP by promoting comprehensive and effective mitigation strategy.

E. CHANGES FROM THE LAST PLAN

The most significant change to this section was the removal of redundant text and reorganization of some other sections. The 2010 plan included the following sections which have now been deleted all together, combined in other sections of this plan, or removed from Section 2: 1) Why Develop a Mitigation Plan?, 2) Planning Meetings, 3) Plan Update Requirement, 4) The Planning Team, 5) Standardization and Applicability of Hazard Assessment Techniques, and 6) Local Plan Integration.

Tables 2.1 and 2.2 were added to show the local mitigation plans and projects that were funded through FEMA's HMA program.

The goals in this current plan have been reprioritized. The ICC determined that the priorities and goals needed to be adjusted to better reflect changing budgets and personnel constraints. This will change the way the State prioritizes mitigation funding and actions pre- and post-disaster.

III. STATE PROFILE

A. INTRODUCTION

South Carolina is comprised of 46 counties. Counties were established in the colonial period primarily for locating land grants, with most other governmental activities being centralized in Charleston. The growth of the backcountry led to the establishment of judicial districts throughout the colony, but low-country areas continued to be identified primarily by their Anglican parish names. Following the Revolution, both district and county courts were established. In 1800, most of the counties became districts. Finally, in 1868 all of the existing districts were renamed counties. New counties continued to be formed until the early part of the 20th century, with the most recent being Allendale in 1919.

B. GEOGRAPHY AND ENVIRONMENT

South Carolina ranks 40th in size among the states, with an area of 82,931 square kilometers (32,020 square miles), including 2,611 square kilometers (1,008 square miles) of inland water and 186 square kilometers (72 square miles) of coastal waters over which it has jurisdiction. The maximum distance, from east to west, is 439 kilometers (273 miles) and its maximum extent north to south is 352 kilometers (219 miles). The state's mean elevation is 110 meters (350 feet)[1].

Three geographic land areas define South Carolina; the Atlantic Coastal Plain, the Piedmont, and the Blue Ridge. Two thirds of South Carolina is covered by the Atlantic Coastal Plain, from the Atlantic Ocean extending to the west. The land rises gradually from the southeast to the northwest. An area of the Atlantic Coastal Plain, defined as extending from the coast about 70 miles inland, is referred to as the Outer Coastal Plain. This area is quite flat. Many rivers can be found in the Outer Coastal Plain, with swamps near the coast that extend inland. An area called the Inner Coastal Plain consists of rolling hills. This is where South Carolina's most fertile soils are found. South Carolinians refer to the Inner Coastal Plain as the South Carolina Low Country and the Piedmont and the Blue Ridge region as Up Country.

To the northwest of the Atlantic Coastal Plain is the Piedmont. The Piedmont is marked by higher elevations, from 400 to 1,200 feet above sea level and reaching 1,400 above sea level on its western edge. The landscape consists of rolling hills, gentler in the east and hillier to the west and northwest. The border between the Piedmont region and the Atlantic Coastal Plain is called the Fall Line to mark the line where the upland rivers "fall" to the lower Atlantic Coastal Plain.

The Blue Ridge covers the northwestern corner of South Carolina. This region is part of the larger Blue Ridge Mountain Range that extends from southern Pennsylvania south to Georgia. The South Carolina Blue Ridge Mountains are lower and less rugged than the mountains in North Carolina. The forest-covered Blue Ridge Mountains of South Carolina rarely exceed 3,000 feet above sea level. The highest point in South Carolina, Sassafras Mountain, reaches an elevation of 3,554 feet.

South Carolina's climate is humid and subtropical, with long, hot summers and short, mild winters. The subtropical climate of South Carolina arises from the combination of the state's relatively low latitude, its generally low elevation, the proximity of the warm Gulf Stream in the Atlantic, and the Appalachian Mountains, which in winter, help to block cold air from the interior of the United States. The average temperature range in Columbia, S.C. is 33.7 to 56.6˚F in January and 70.8 to 92.3˚F in July. The record low in the state was -19˚F in 1985 in Caesars Head and the record high was 113˚F in June 2012 in Columbia.[2]

Rainfall is abundant and well distributed throughout South Carolina. Most of the state receives, on average, 49 inches of precipitation per year.[3] Nearly all precipitation falls as rain, and most precipitation occurs during the spring and summer. The Pee Dee, Santee, Edisto, and Savannah River systems drain the state, flowing from the highlands to the sea, creating rapids and waterfalls. This abundant source of hydroelectric power is one of South Carolina's most important natural resources.

C. POPULATION AND HOUSING- STATE CHARACTERISTICS

The 2010 Census for South Carolina estimates the state's populations at 4,625,364, ranking 24th among the 50 states in terms of population size.[4] From 2000 to 2010, South Carolina's population increased by 15.3 percent (from 4,012,012 people to 4,625,364 people). South Carolina is the nation's 10th fastest-growing state,[5] increasing its population by 16.6 percent between 2000 and 2011. The Untied States grew by 10.7 percent during the same time period per 2010 Census. **Figure 3.1** compares the rate of population growth of South Carolina and the United States.

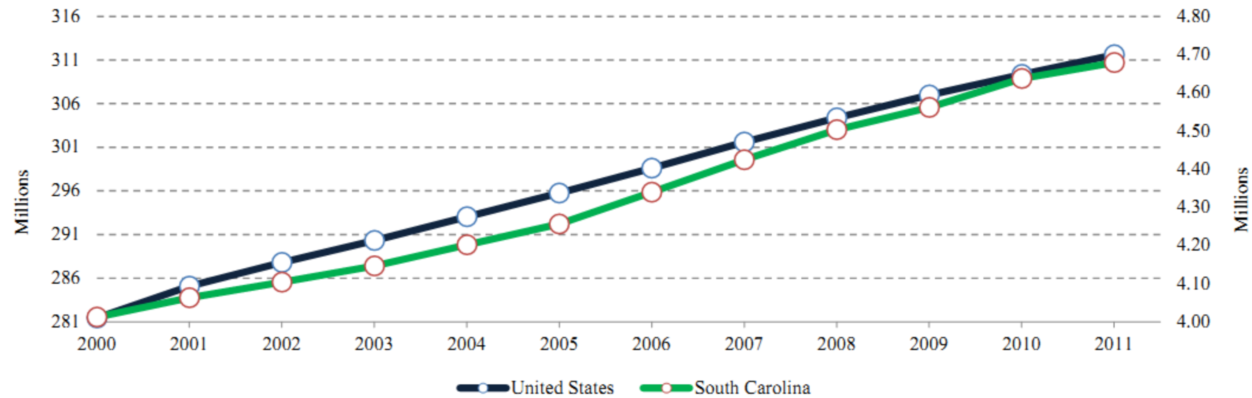


FIGURE 3.1—POPULATION GROWTH 2000- 2011
Source: SC Department of Commerce

According to 2010 Census, a housing unit is a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied (or if vacant, is intended for occupancy) as separate living quarters. Separate living quarters are those in which the occupants live and eat separately from any other person in the building and which have direct access from the outside of the building or through a common hall. Data collected from the 2010 Census, estimated 2.1 million housing units in South Carolina.[6] Of those, 1.7 million were occupied housing units and 545,360 were occupied rental units. A housing unit is owner-occupied if the owner or co-owner lives in the unit, even if it is mortgaged or not fully paid for. The average household size of owner-occupied was 2.51 people and average size of renter-occupied was 2.45 people.[7] Families made up 67.4 percent of the households in South Carolina, which includes both married-couple families (48.3 percent) and other families (19.1 percent). Non-family households made up 32.6 percent of all households in South Carolina. Most of the non-family households were people living alone, but some were comprised of people living in households in which no one was related to the householder.[8]

Of the total housing units, single-unit structures dominate the housing stock at 82.6 percent. Multi-unit structures make up 17.4 percent. The median value of owner-occupied housing units was $137,000 per 2010 Census.[9]

Per USFN, a mortgage banking resource, South Carolina has one of the highest numbers of manufactured home sales in the country. According to industry estimates, manufactured homes account for roughly 60 percent of all new single-family housing in the state.[10] In 2008, the U.S. Census Bureau stated that South Carolina was ranked first nationally for total number of mobile home housing units. Of the total housing units, 18.1% were mobile homes.[11]

Data from the 2010 Census showed 64.6 percent of the people living in South Carolina have lived in the same residence at least 5 years; 8.1 percent had moved during the past year from another residence in the same county, 3 percent from another county in the same state, 3.2 percent from another state, and .4 percent from abroad. Only 4.5 percent of the people living in South Carolina in

2010 were foreign born, whereas, 95.5 percent were native, including 59.2 percent who were born in South Carolina.[12]

The South Carolina employment rate of non-institutionalized population in 2010 had 27.3 percent reporting a disability. The likelihood of having a disability varied by age from 3.6 percent of people under 18 years old, to 11.9 percent of people 18 to 64 years old, and to 40.0 percent of those 65 and older.[13]

Regarding education, 83.6 percent of people 25 years and over had at least graduated from high school and 24.3 percent had a bachelor's or a higher degree.[14]

D. POPULATION AND HOUSING—COUNTY CHARACTERISTICS

Table 3.1 provides a breakdown of population, housing units, land and water area, and density by county. This information was derived from 2010 Census. Greenville County has the largest population and number of housing units in the state. The coastal counties including Beaufort, Charleston, and Horry have higher population than state average. **Figure 3.2**, Distribution of General Population Density by Census Tract, 2010, shows the geographic variations in density by county throughout the state.

TABLE 3.1—COUNTY POPULATIONS, NUMBER OF RESIDENTIAL BUILDINGS AND LAND AREA, 2010

COUNTY	POPULATION	HOUSING UNITS	AREA IN SQUARE MILES			DENSITY PER SQUARE MILE	
			TOTAL AREA	WATER AREA	LAND AREA	POPULATION	HOUSING
Abbeville	25,417	12,079	510.99	20.51	490.48	51.8	24.6
Aiken	160,099	72,249	1,080.60	9.56	1,071.03	149.5	67.5
Allendale	10,419	4,486	412.42	4.33	408.09	25.5	11.0
Anderson	187,126	84,774	757.44	42.01	715.43	261.6	118.5
Bamberg	15,987	7,716	395.56	2.19	393.37	40.6	19.6
Barnwell	22,621	10,484	557.26	8.87	548.39	41.2	19.1
Beaufort	162,233	93,023	923.40	347.12	576.28	281.5	161.4
Berkeley	177,843	73,372	1,229.24	130.38	1,098.86	161.8	66.8
Calhoun	15,175	7,340	392.48	11.33	381.15	39.8	19.3
Charleston	350,209	169,984	1,358.00	441.91	916.09	382.3	185.6
Cherokee	55,342	23,997	397.18	4.52	392.66	140.9	61.1
Chester	33,140	14,701	586.16	5.51	580.66	57.1	25.3
Chesterfield	46,734	21,482	805.75	6.67	799.08	58.5	26.9
Clarendon	34,971	17,467	695.65	88.71	606.94	57.6	28.8
Colleton	38,892	19,901	1,133.29	76.79	1,056.49	36.8	18.8
Darlington	68,681	30,297	566.80	5.65	561.15	122.4	54.0
Dillon	32,062	13,742	406.59	1.72	404.87	79.2	33.9
Dorchester	136,555	55,186	576.81	2.57	573.23	238.2	96.3
Edgefield	26,985	10,559	506.70	6.29	500.41	53.9	21.1
Fairfield	23,956	11,681	709.88	23.60	686.28	34.9	17.0
Florence	136,885	58,666	803.73	3.76	799.96	171.1	73.3
Georgetown	60,158	33,672	1,034.65	221.10	813.55	73.9	41.4
Greenville	451,225	195,462	794.87	9.75	785.12	574.7	249.0
Greenwood	69,661	31,054	462.93	8.20	454.73	153.2	68.3
Hampton	21,090	9,140	562.71	2.81	559.90	37.7	16.3
Horry	269,291	185,992	1,255.00	121.11	1,133.90	237.5	164.0
Jasper	24,777	10,299	699.36	44.04	655.32	37.8	15.7
Kershaw	61,697	27,478	740.40	13.83	726.56	84.9	37.8
Lancaster	76,652	32,687	555.12	5.96	549.16	139.6	59.5

COUNTY	POPULATION	HOUSING UNITS	AREA IN SQUARE MILES			DENSITY PER SQUARE MILE	
			TOTAL AREA	WATER AREA	LAND AREA	POPULATION	HOUSING
Laurens	66,537	30,709	723.84	10.04	713.80	93.2	43.0
Lee	19,220	7,775	411.23	1.05	410.18	46.9	19.0
Lexington	262,391	113,957	757.73	58.82	698.91	375.4	163.0
Marion	33,062	14,953	494.14	4.91	489.23	67.6	30.6
Marlboro	28,933	12,072	485.27	5.60	479.67	60.3	25.2
McCormick	10,233	5,453	393.87	34.74	359.13	28.5	15.2
Newberry	37,508	17,922	647.29	17.25	630.04	59.5	28.4
Oconee	74,273	38,763	673.51	478.18	626.33	118.6	61.9
Orangeburg	92,501	42,504	1,127.90	21.80	1,106.10	83.6	38.4
Pickens	119,224	51,244	512.03	15.62	496.41	240.2	103.2
Richland	384,504	161,725	771.71	14.64	757.07	507.9	213.6
Saluda	19,875	9,289	461.82	9.04	452.78	43.9	20.5
Spartanburg	284,307	122,628	819.24	11.32	807.93	351.9	151.8
Sumter	107,456	46,011	682.08	17.02	665.07	161.6	69.2
Union	28,961	14,153	516.03	1.86	514.17	56.3	27.5
Williamsburg	34,423	15,359	937.04	2.88	934.16	36.8	16.4
York	226,073	94,196	695.81	15.21	680.60	332.2	138.4
TOTAL	**4,625,364**	**2,137,683**	**32,020.49**	**1,959.79**	**30,060.70**	**153.9**	**71.1**

Source: U.S. Census Bureau, 2010

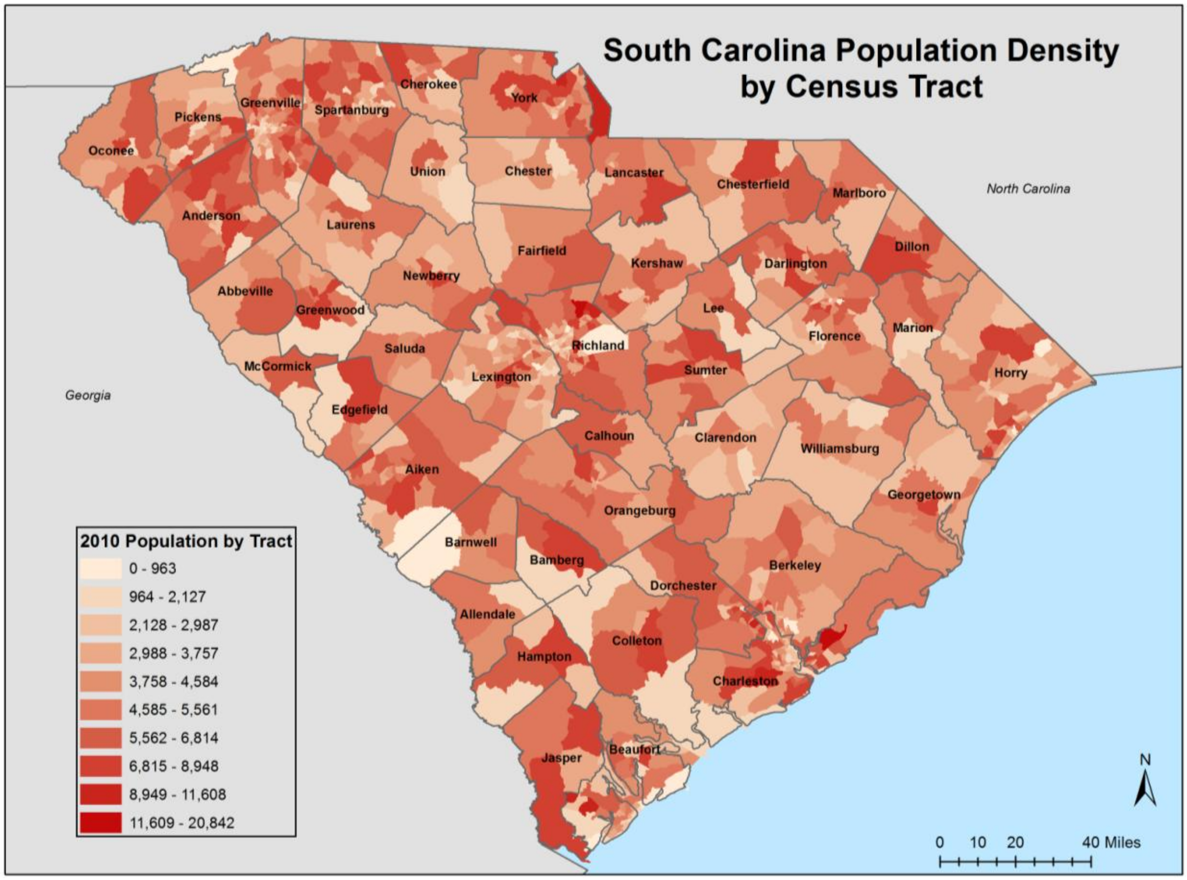


FIGURE 3.2—DISTRIBUTION OF GENERAL POPULATION DENSITY BY CENSUS TRACT, 2010
Source: U.S. Census Bureau, 2010

Natural hazard events strike communities equally and without boundaries. Conversely, the ability for society to prepare for and recover from an event may not be equal. Individuals and groups of people can be affected differently based on their diverging capacities and abilities to handle the impact of the hazard event. The term "social vulnerability" describes the underlying, pre-event social and demographic characteristics of a population that cause differential affects of hazards. These characteristics include, but are not limited to, age, gender, population, race, income, and the number of mobile homes found in each county. For example, people under age 19 or over age 64 are more vulnerable than the general population due to the need for special assistance should an evacuation be required in an emergency.

In a report released by the Office of the Lieutenant Governor, Office on Aging, South Carolina has experienced a significant growth of seniors or mature adults over the last few decades.[15] The baby boom has begun to have a dramatic impact and will continue to affect the nation and South Carolina's communities and institutions over the next twenty years. **Table 3.2** shows the state's population has grown from 286,272 persons aged 60 and over since 1970 to 651,482 in 2000, a 12.8 percent increase in thirty years. The population 60 years and over is projected to increase to 1,450,487 by the year 2030, a 123 percent increase from 2000**.**

TABLE 3.2—SOUTH CAROLINA POPULATION BY AGE (1970-2030)

South Carolina Population by Age 1970-2030							
	1970	**1980**	**1990**	**2000**	**2010**	**2020**	**2030**
50 to 54	131,916	149,126	159,507	262,543	326,406	309,755	302,530
55 to 59	115,021	149,937	148,762	206,762	302,301	339,621	305,344
60 to 64	95,312	128,816	144,020	166,149	270,852	332,083	316,028
65 to 69	74,257	110,235	140,455	145,599	200,488	289,980	325,913
70 to 74	50,967	79,292	105,850	124,449	142,661	232,716	286,921
75 to 84	53,117	77,797	119,881	165,016	184,258	244,666	380,339
Total 60+	286,272	416,144	540,955	651,482	876,512	1,198,333	1,450,487
Total 65+	190,171	287,328	396,935	485,333	605,660	866,250	1,134,459
Total 75+	65,736	97,801	150,630	215,285	262,511	343,554	521,625
Total 85+	11,830	20,004	30,749	50,269	78,253	98,888	141,286
Source: 1970-2000 Projections: US Census Bureau Decennial Census 1970, 1980, 1990, and 2000. 2010-2025 Projections: US Census Bureau, Population Division, Interim State Population Projections, 2005.							

Figure 3.3 shows the distribution of elderly population density. The counties with the largest percentage concentration of persons 60 years or older were McCormick, Beaufort, Georgetown, Oconee, Orangeburg, and Union.

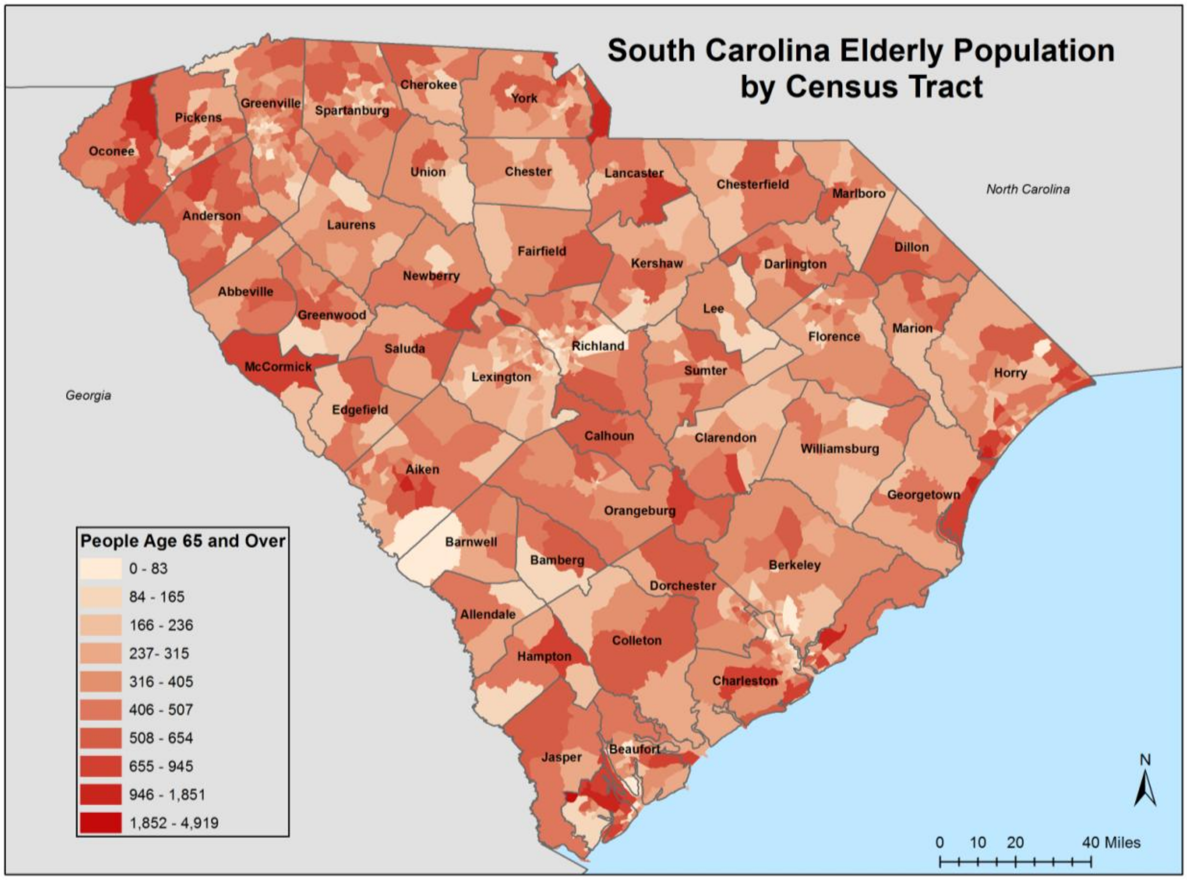


FIGURE 3.3— DISTRIBUTION OF ELDERLY POPULATION DENSITY BY CENSUS TRACT, 2010
Source: U.S. Census Bureau, 2010

Figure 3.4 shows the distribution of South Carolina's impoverished population. Greenville, Charleston, Richland, Spartanburg, and Horry Counties scored highest among the 46 counties in the state. These counties also have the highest general population.

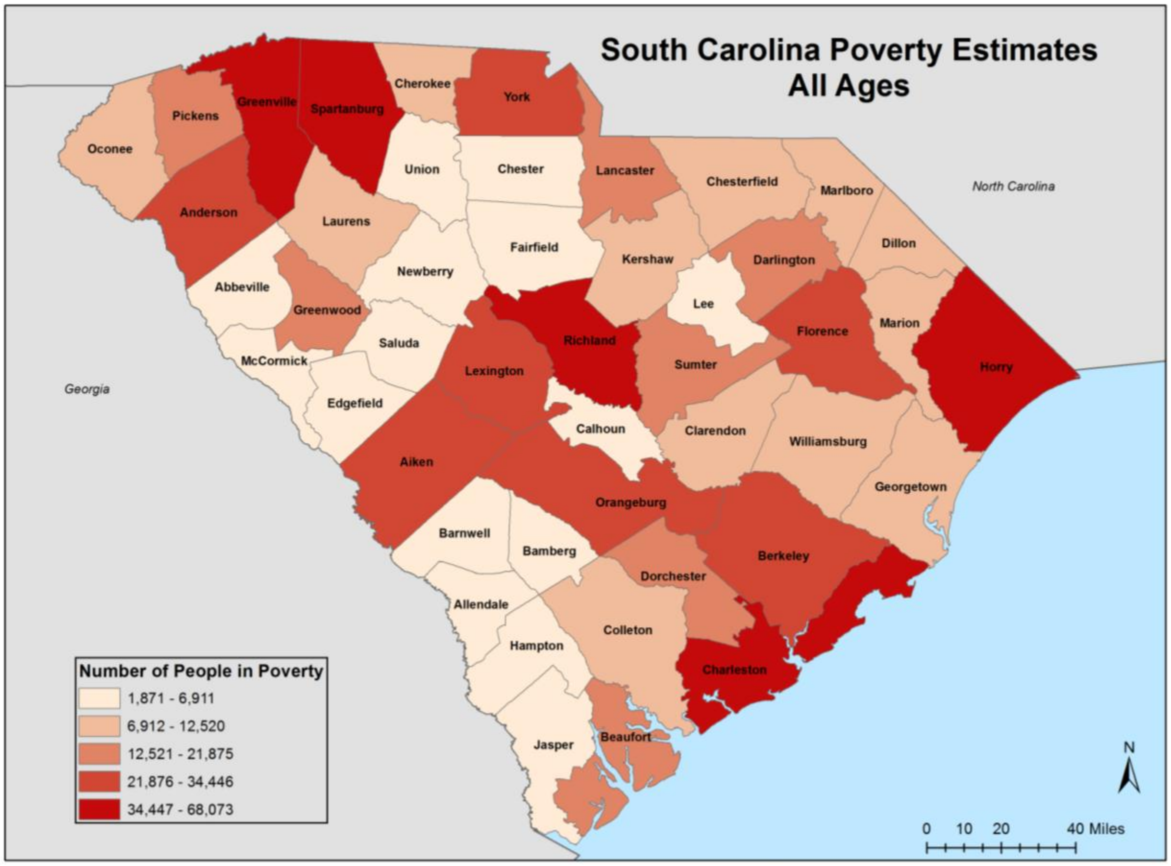


FIGURE 3.4—LOW INCOME POPULATION BY COUNTY
Source: U.S. Census Bureau, 2010

Figure 3.5 depicts the medium household income based on the 2010 Census. Greenville, York, Lexington, Richland, Berkeley, Dorchester, Charleston, and Beaufort counties have the highest median household income, all over $43,197.00. These counties are all in proximity to major cities with a greater access to jobs and resources. The median household income in South Carolina in 2011 was $42,367.

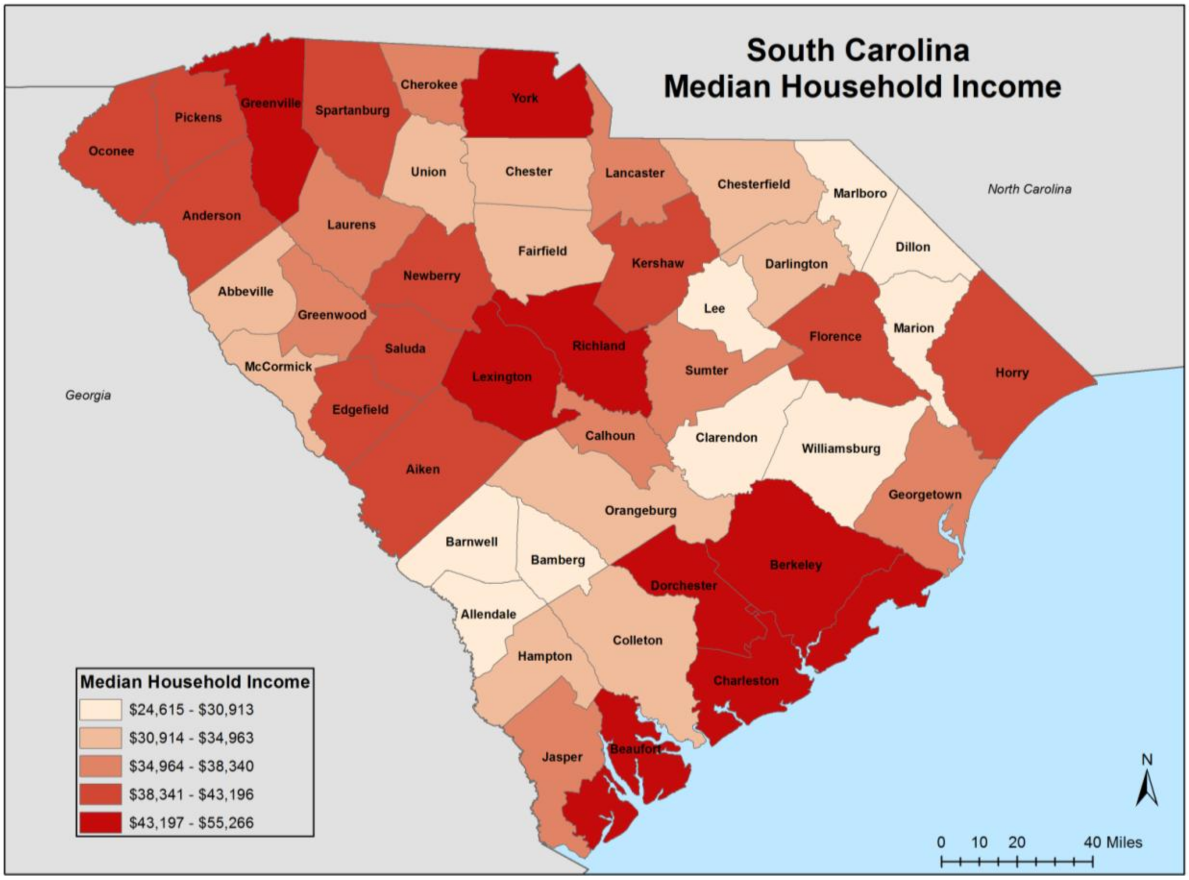


FIGURE 3.5—MEDIAN HOUSEHOLD INCOME BY COUNTY
Source: U.S. Census Bureau, 2010

Table 3.3 provides projected total population by county in years 2015, 2025, and 2030, percent population change from 2000 to 2025, and number of tourists per day. Population projections indicate consistent growth in the state with the total population exceeding five million by 2025. Most coastal counties, with the exception of Charleston and Colleton are expected to experience higher population growth than the state average. Horry County represents the fastest growing county in the state. A similar trend is found for the number of visitors among 46 counties.

TABLE 3.3—SOUTH CAROLINA PROJECTED TOTAL POPULATION, SOCIAL VULNERABILITY SCORES, AND TOURIST POPULATION

COUNTY	PROJECTED POPULATION IN 2015	PROJECTED POPULATION IN 2025	PROJECTED POPULATION IN 2030	PROJECTED POPULATION CHANGE 2000-2025	MAXIMUM DAILY VISITORS
Abbeville	25,300	25,000	24,900	8.5%	1,590
Aiken	165,600	176,800	182,500	31.3%	4,469
Allendale	10,300	10,000	9,900	-2.4%	599
Anderson	193,300	209,000	218,500	26.8%	7,281
Bamberg	15,800	15,400	15,200	-18.2%	767
Barnwell	22,400	22,100	22,000	12.8%	673
Beaufort	175,900	202,400	215,300	65.1%	62,731
Berkeley	187,800	208,400	219,100	42.7%	5,029
Calhoun	15,200	15,100	15,100	14.5%	890
Charleston	360,600	383,800	396,700	21.1%	64,908
Cherokee	56,100	57,000	57,300	23.3%	1,834
Chester	32,900	32,500	34,400	4%	1,357
Chesterfield	47,800	49,600	50,300	10%	1,248
Clarendon	35,600	37,400	38,600	15.4%	7,339
Colleton	39,000	39,300	39,500	16.8%	8,024
Darlington	69,000	69,900	70,500	6.2%	1,519
Dillon	32,400	33,100	33,400	.006%	2,287
Dorchester	152,000	178,800	190,200	65.1%	2,446
Edgefield	27,600	29,200	30,100	30.6%	603
Fairfield	24,100	24,300	24,500	10.5%	2,001
Florence	140,000	147,000	150,900	17.4%	8,245
Georgetown	61,300	63,800	65,100	31.2%	16,308
Greenville	473,300	518,800	542,300	36.4%	21,257
Greenwood	70,600	73,100	74,700	16.8%	2,867
Hampton	21,000	20,800	20,700	13.3%	908
Horry	294,600	345,800	371,700	74.2%	200,783
Jasper	26,000	28,000	28,800	34.1%	4,642
Kershaw	64,400	70,000	72,800	35.6%	4,439

COUNTY	PROJECTED POPULATION IN 2015	PROJECTED POPULATION IN 2025	PROJECTED POPULATION IN 2030	PROJECTED POPULATION CHANGE 2000-2025	MAXIMUM DAILY VISITORS
Lancaster	81,700	91,000	95,300	33.4%	857
Laurens	65,800	65,000	65,000	21.2%	3,215
Lee	19,000	18,700	18,600	7.6%	434
Lexington	277,100	312,500	333,200	45.5%	7,740
Marion	32,500	31,900	31,800	-.0005%	769
Marlboro	29,000	29,100	29,200	-9%	2,273
McCormick	10,300	10,600	10,900	22.2%	1,090
Newberry	37,900	39,00	39,800	16.8%	3,742
Oconee	76,600	84,000	89,100	31%	7,493
Orangeburg	92,800	93,500	94,100	8%	8,838
Pickens	121,600	128,300	132,900	29.6%	3,978
Richland	404,400	440,100	456,000	28%	20,927
Saluda	20,000	20,300	20,400	10.2%	1,363
Spartanburg	295,100	318,500	331,200	27.5%	8,814
Sumter	108,200	109,200	109,500	12.2%	2,889
Union	28,700	28,300	28,100	-9.7%	687
Williamsburg	33,800	33,000	32,900	-6%	873
York	248,800	296,100	320,700	63.9%	8,162
TOTAL	**4,823,200**	**5,235,500**	**5,451,700**	**21.21%**	**521,191**

Source: U.S. Census Bureau, South Carolina Office of Research and Statistics

E. EMPLOYMENT AND INDUSTRY

South Carolina remained primarily an agricultural state until the early decades of the 20th century, when manufacturing, particularly the textile industry, developed as the leading economic activity. Nevertheless, agriculture remains an important part of the state's economy. The state's farm output, especially its production of cotton, still provides raw materials for many of its manufacturing plants. While the production of textiles remains important to the economy, manufacturing has become more diversified since the 1960s.

Today South Carolina's economy is no longer dependent on any one sector. In fact, South Carolina was ranked #1 for Economic Growth Potential in the 2010 State Ranking Report by Business Facilities.[16] A look at the distribution of jobs by industry in 2012 show that Government is the largest industry at 18.8%, followed by professional and business services (12.5%), retail trade (12.1%), manufacturing (12%), education and health services (11.9%), hospitality (11.3%), finance, insurance, and real estate (5.1%), construction (4%), wholesale trade (3.6%), and transportation, warehousing, and utilities (3.4%).[17] The top ten agricultural products marketed in 2011 were chicken broilers, with 32.8% of total receipts, followed by turkeys, greenhouse and nursery products, cotton, cattle/calves, corn, eggs, soybeans, wheat, and peaches.[18]

Table 3.4 shows the overall employment figures in the state. The state experienced an increase in unemployment from 1998 – 2010, but has since seen a slow decrease in unemployment. As of November 2012, hospitality, construction, and professional and business service sectors experienced the greatest decline in employment.

TABLE 3.4—EMPLOYMENT AND UNEMPLOYMENT IN SOUTH CAROLINA, 1998-2012

YEAR	CIVILIAN LABOR FORCE	TOTAL EMPLOYMENT	TOTAL UNEMPLOYMENT	UNEMPLOYMENT AS PERCENT OF LABOR FORCE
1998	1,962,922	1,888,237	74,685	3.8
1999	1,963,273	1,875,433	87,840	4.4
2000	1,975,919	1,900,817	75,102	3.8
2001	1,951,986	1,847,944	104,042	5.3
2002	1,968,479	1,851,214	117,265	6.0
2003	2,002,797	1,868,434	134,363	6.7
2004	2,026,480	1,888,050	138,430	6.8
2005	2,062,350	1,922,367	139,983	6.8
2006	2,104,453	1,970,411	134,042	6.3
2007	2,117,792	1,998,640	119,152	5.6
2008	2,142,643	1,995,357	147,286	6.9
2009	2,179,366	1,930,305	224,990	10.4

2010	2,149,837	1,909,227	240,610	11.2
2011	2,157,507	1,935,804	221,703	10.3
2012	2,147,073	1,950,186	196,887	9.16

Source: S.C. Department of Employment and Workforce and Bureau of Labor Statistics

Note: The labor force data in this table is adjusted to the Current Population Survey Benchmark, and has been adjusted for commuting and dual job holding.

F. TOURISM

Tourism is the largest driver of economic growth along the Grand Strand of South Carolina. Visitor spending has an annual economic impact on the region of $6.5 billion and supports a total of 75,000 jobs in Horry and Georgetown Counties combined. The municipalities located directly on the Atlantic Ocean owe a majority of their overall economic activity to tourism and the annual flow of visitor spending.[19]

According to South Carolina Department of Parks Recreation and Tourism, in 2007 nearly 40% of all visitors to South Carolina came for recreational purposes (beaches, entertainment, etc.) Of all out-of-state vacationers in South Carolina in 2007, 46.5% visited for beaches, 38% for shopping, 26% for fine dining and 13% for golfing. In 2007, tourism in South Carolina generated $7.3 billion in wages and salaries and equaled 12.6% of the total state employment. Total value of tourism equaled $11.6 billion or 7.6% of the total state economy.[20]

G. LAND USE

The National Resource Inventory report by the United States Department of Agriculture (USDA) indicates that between 1992 and 1997, 15.8 million acres were converted from farms and woodlands to a developed land status nationally. Among individual states, South Carolina was in the top 10, with 539,700 rural acres converted for development between 1992 and 1997. The report indicated that South Carolina had the 9th highest rate of land conversion among the 50 states.[21]

Table 3.5 shows where South Carolina stands in comparison to other states. Land conversion rates have been over 20 percent per decade for some time. During the five-year periods of 1982-87 and 1987-92, conversion rates amounted to 13.0 and 14.1 percent, respectively. Over the five-year period between 1992 and 1997, the rate of increase more than doubled to 30.2 percent.

TABLE 3.5—LAND CONVERSION BY STATE ADJUSTED BY ACREAGE AND POPULATION, 1992-1997

RANKING	STATE	PERCENTAGE OF TOTAL RURAL LAND CONVERTED TO DEVELOPMENT FROM 1992 TO 1997
1	West Virginia	38.8%
2	New Mexico	35.7%
3	Pennsylvania	35.0%
4	Georgia	33.1%
5	Tennessee	30.5%
6	South Carolina	30.2%
7	Maine	29.0%
8	Missouri	23.3%
9	North Carolina	23.0%
10	Alabama	22.7%

Source: USDA, U.S. Census Bureau and Jim Self Center on the Future, Clemson University

While updated figures are not available, and assuming these rates of conversion are not anomalies, long-term community planning will become ever more valuable. Such planning helps cities and towns manage land development, ensuring their community benefits from growth.

The South Carolina General Assembly grants local governments the authority to plan and control land use and development through the creation and maintenance of a comprehensive plan. In 1994, the General Assembly passed the "South Carolina Local Government Comprehensive Planning Enabling Act." This act required all South Carolina local planning programs to make their plans and ordinances conform to the provisions in the 1994 act by May 3, 1999. Each comprehensive plan developed by a county or municipality is required to directly address, at a minimum, seven elements, including a natural resource element. The natural resource element must address flooding and flood-related issues.

The purpose of these plans is to allow local governments to devise a strategy to accomplish the following five objectives:

1. Identify local problems and needs
2. Collect appropriate data to study local problems and needs
3. Arrive at a consensus on local objectives
4. Develop plans and programs to fulfill such objectives
5. Utilize available resources to execute plans and programs effectively

Jurisdictional planning boards, state and local economic development leaders, and state natural resource managers are working to incorporate a variety of land-use management initiatives into these comprehensive plans.

The effects of land use changes, development and populations growth are addressed in greater detail in the Risk Assessment.

H. DECLARED DISASTERS

Since 1954, South Carolina has experienced twenty-one federally declared disasters, of which fifteen were major disaster declarations, which allowed for mitigation funding to be made available. The list of federally declared disasters, emergency declarations and fire management assistance declarations as compiled by FEMA, is shown in **Table 3.6**. The types of hazards that led to these disaster declarations are ice storms, fires, winter storms, and hurricanes.

TABLE 3.6—DECLARED DISASTERS, SOUTH CAROLINA, 1954-2009

YEAR	DATE	DISASTER	DECLARATION
2009	4/23	Highway 31 Fire	Fire Management Assistance Declaration
2006	01/20	Severe Ice Storm	Major Disaster Declaration
2005	09/10	Hurricane Katrina Evacuation	Emergency Declaration
2004	10/07	Tropical Storm Frances	Major Disaster Declaration
2004	09/15	Tropical Storm Gaston	Major Disaster Declaration
2004	09/01	Hurricane Charley	Major Disaster Declaration
2004	02/13	Ice storm	Major Disaster Declaration
2003	01/08	Ice storm	Major Disaster Declaration
2002	06/18	Legends Fire	Fire Management Assistance Declaration
2001	11/13	Long Bay Fire	Fire Management Assistance Declaration
2000	01/31	Winter storm	Major Disaster Declaration
1999	09/21	Hurricane Floyd	Major Disaster Declaration
1999	09/15	Hurricane Floyd	Emergency Declaration
1998	09/04	Hurricane Bonnie	Major Disaster Declaration
1996	09/30	Hurricane Fran	Major Disaster Declaration
1990	10/22	Flood	Major Disaster Declaration
1989	09/21	Hurricane Hugo	Major Disaster Declaration
1984	03/30	Severe storms, Tornadoes	Major Disaster Declaration
1977	08/04	Drought	Emergency Declaration
1955	08/20	Hurricanes	Major Disaster Declaration
1954	10/17	Hurricane Hazel	Major Disaster Declaration

Source: FEMA.gov, List of Federally Declared Disasters

The most recent disaster declaration came in January 2006 following a severe ice storm. FEMA designated the counties of Anderson, Cherokee, Greenville, Laurens, Oconee, Pickens, and Spartanburg as a disaster area therefore making those counties eligible for federal disaster funds to help local governments recover from the ice storm. The declaration covered damage to public property from the storm that occurred in mid-December, 2005. Under a declaration of disaster, the state and affected local governments are eligible to apply for federal funding to pay 75 percent of the approved costs for debris removal, emergency services related to the storm, and the repair or replacement of damaged public facilities.

Hurricane Hugo in 1989 is well known in the state as one of the most significant disasters. While Hugo resulted in $10 billion in damage, the cost to South Carolina included:[22]

1. 26 deaths;
2. Some 750,000 residents were without power; 100,000 customers were still without power two weeks later;
3. 42,650 storm victims applied to FEMA for disaster assistance;
4. 74,839 persons applied to FEMA for emergency housing help;
5. $4.2 billion in losses to South Carolina alone;
6. $31 million was provided for emergency housing assistance;
7. $10.7 million was provided to help reduce future storm losses;
8. U.S. Small Business Administration made 8,798 disaster loans totaling $200 million; and
9. National Guard accumulated a record 48,557 staff days of storm-related work.

I. CHANGES FROM THE LAST PLAN

As a result of the plan update completed in Spring 2013, this section was reviewed and analyzed by the ICC and subsequently updated to include the most recent information and statistics (population, demographics, disaster declarations, etc). The 2000 Census statistics were updated to reflect the 2010 Census data, although not all variables were captured in the 2010 Census. In addition, more detailed information on SC's elderly population and manufactured housing was included. A section on tourism was also added to highlight the economic importance of this industry for the State.

IV. HAZARD ASSESSMENT

EMAP STANDARD
4.3.1: *The Emergency Management Program shall identify the natural and human-caused hazards that potentially impact the jurisdiction using a broad range of sources. The Emergency Management Program shall assess the risk and vulnerability of people, property, the environment, and its own operation from these hazards.*

EMAP STANDARD
4.3.2: *The Emergency Management Program shall conduct a consequence analysis for the hazards identified in 4.3.1 to consider the impact on the public; responders; continuity of operations including continued delivery of services; property, facilities, and infrastructure; the environment; the economic condition of the jurisdiction and public confidence in the jurisdiction's governance.*

A. INTRODUCTION

South Carolina is diverse in its geography, population, and the types of hazards to which the state is exposed. Hazard exposure, risk, and social vulnerability for South Carolina vary across the state; therefore, the impacts of hazard events may affect some portions of the state and its residents more than others. It is important to understand and account for this variability for successful hazard response and mitigation planning purposes.

The purpose of this risk assessment is to analyze the major hazards that affect South Carolina. Some hazards impact the state more so than others (e.g. hurricanes versus landslides). A complete analysis has been performed for those hazards that are more likely to cause adverse impacts to people and property of South Carolina. For those hazards that pose a minimal risk, a brief description is provided, but no further analysis is presented. These hazard types include sink holes, landslides, public health emergencies, nuclear power plants, tsunamis, and terrorism. For the majority of the analyses, and where it was available, data was collected through 2011. Sections that discuss 'recent' events use the time frame of 2009 through 2011, as a continuation from the previous South Carolina Hazard Mitigation Plan in which 2007-2009 data was used. Data for the risk assessment derive primarily from the Spatial Hazard Events and Loss Database for the United States (SHELDUS) and the Storm Events Database from the National Climatic Data Center (NCDC), as well as from a variety of other sources from state and local agencies. From these data sources, the historical hazard frequency of occurrence (risk) and losses are examined. Additionally, HAZUS-MH, FEMA's loss estimation software was used to model and provide estimates of potential impact.

The Hazus-MH risk assessment method is parametric, in that distinct hazard and inventory *parameters* (for example, wind speed and building types) were modeled using the Hazus-MH software to determine the impact (damages and losses) on the built environment. Hazus-MH was used to estimate losses from hurricane winds and earthquake hazards. The baseline data in Hazus continually undergoes updates, such as the statewide essential facility data update in 2009.

State-owned facilities were analyzed across wind, flood and earthquake hazards using HAZUS-MH. The assessment of state-owned facilities will only address those structures 3,000 square feet and larger. There are two reasons for limiting the vulnerability assessment to buildings 3,000 square feet and larger. First, the state's Insurance Reserve Fund Program only insures buildings 3,000 square feet and larger because they determined that buildings of this size accounted for the majority of exposure. In addition, the Insurance Reserve Fund Program provided SCEMD with structural information for buildings 3,000 square feet and larger. Future updates will include an assessment of infrastructure such as roads and bridges as detailed information becomes available.

Federal properties were not assessed due to the lack of available data and the authority to implement appropriate mitigation measures. Properties owned by local governments are addressed in local hazard mitigation plans, and therefore, are not included in this plan.

Each hazard type is given a section of its own and follows the general outline of first identifying the hazard with a brief overview, followed by subsections on the hazard type's formation, classification (if applicable), location (in a broad geographic sense of where the hazard type occurs in the state), historical events, recent activity, and lastly, a section on vulnerability that examines historical frequency, risk, and losses. This last section includes numerous tables and figures to supplement the discussion.

A1. SOCIAL VULNERABILITY

Social vulnerability is considered in this document to analyze the underlying characteristics of the population that either attenuate or exacerbate the effects of hazard events. The Social Vulnerability Index (SoVI), first implemented at the county level for the entire United States, provides a peer reviewed methodology for creating a standardized comparative metric aimed at understanding differences in socio-economic and demographic information between places[23]. SoVI includes those population characteristics known to influence the ability of social groups and communities to prepare for, respond to, and recover from disasters[24]. Key social indicators that consistently appear in the literature as influencing pre-impact preparedness and post-event response and recovery include attributes such as socioeconomic status (wealth, education, occupation), age (elderly populations and young children are more vulnerable); gender; race and ethnicity; employment and employment sector; and special needs populations. However, it is not just the proportion of residents in these broad categories that is important, but instead how race, socioeconomic status, and gender interact to produce socially vulnerable populations. Selecting one variable (race, gender, socioeconomic status) does not adequately capture communities that are described as African American female-headed households below the poverty level, because not all African

Americans are in poverty; not all female-headed households are African American; and not all people in poverty are females or female-headed households.

SoVI synthesizes these socioeconomic variables into multiple dimensions and sums the values to produce the overall score for the particular spatial unit (e.g. county, census tract) of interest. This report implements the SoVI metric at the county level for the entire state so that planners and emergency managers can 1) quickly identify broad differences across the state, and 2) begin to understand, at sub-county levels, the characteristics of their populations and how these are increasing or decreasing vulnerability to better identify where resources and attention should be directed for planning and mitigation. **Figure 4.A1.1** provides the state's demographic distribution at the census tract level data from Census 2010. **Table 4.A1.1** provides a breakdown by county of population, land and water area, and population and housing densities, derived from Census 2010. South Carolina has a total population of 4,854,100 people, as counted in Census 2010. Greenville County has the highest population overall and the highest population density. **Table 4.A1.2** provides a summary on state-owned facilities and their values by county.

Based on the SoVI methodology, Union County has the lowest score, meaning it is the least vulnerable (colored blue), while Saluda County has the highest social vulnerability score, meaning it is most vulnerable (colored red). The scores are mapped (**Figure 4.A1.2**) using a three-class standard deviation model where greater than 0.5 standard deviation means elevated; 0.5 to -0.5 means moderate; and less than -0.5 means limited.

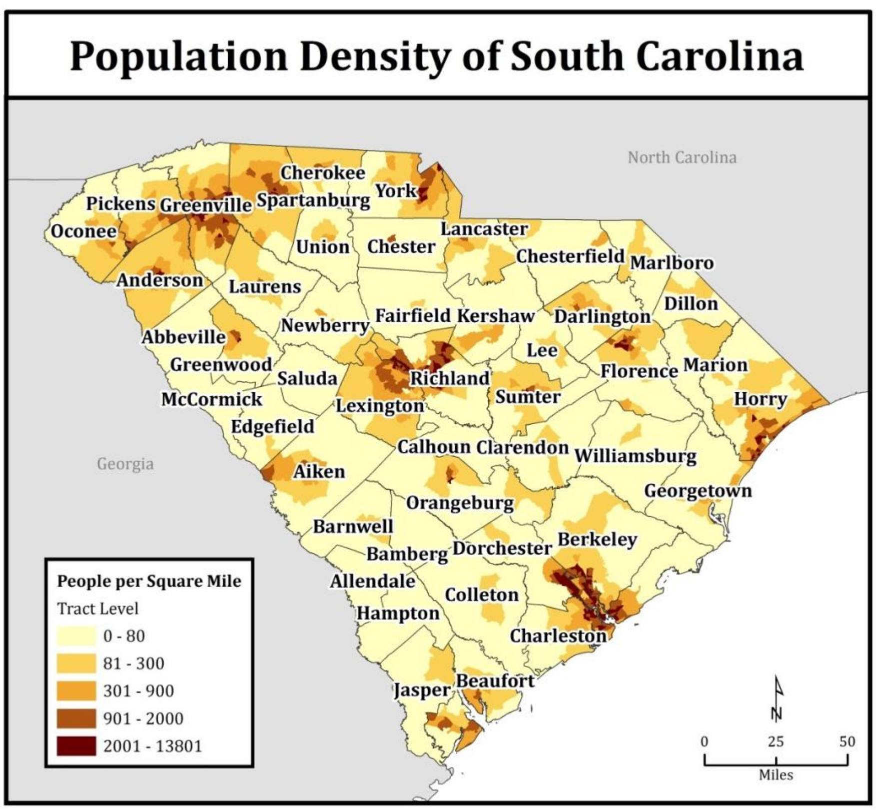


FIGURE 4.A1.1—DENSITY OF GENERAL POPULATION BY CENSUS TRACT (2010)

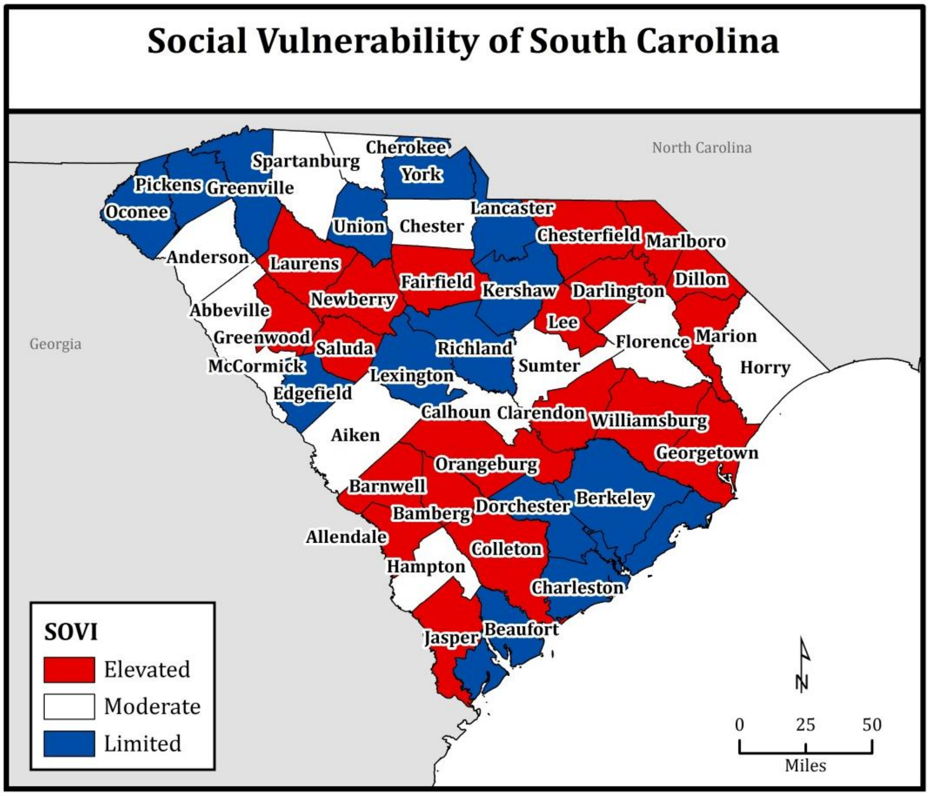


FIGURE 4.A1.2—SOCIAL VULNERABILITY OF SOUTH CAROLINA

TABLE 4.A1.1—DEMOGRAPHIC INFORMATION FOR SOUTH CAROLINA COUNTIES

County	Population	Area in Square Miles			Population Density	SoVI
		Land Area	Water Area	Total Area		
Abbeville	25,417	490.48	20.51	510.99	51.82	0.00
Aiken	160,099	1,071.03	9.56	1,080.60	149.48	-1.14
Allendale	10,419	408.09	4.33	412.42	25.53	1.22
Anderson	187,126	715.43	42.01	757.44	261.56	-0.96
Bamberg	15,987	393.37	2.19	395.56	40.64	1.56
Barnwell	22,621	548.39	8.87	557.26	41.25	1.26
Beaufort	162,233	576.28	347.12	923.40	281.52	-1.71
Berkeley	177,843	1,098.86	130.38	1,229.24	161.84	-4.28
Calhoun	15,175	381.15	11.33	392.48	39.81	-0.28
Charleston	350,209	916.09	441.91	1,358.00	382.29	-1.93
Cherokee	55,342	848.08	15.82	863.90	201.20	0.44
Chester	33,140	580.66	5.51	586.16	57.07	-1.08
Chesterfield	46,734	799.08	6.67	805.75	58.49	1.33
Clarendon	34,971	606.94	88.71	695.65	57.62	0.75
Colleton	38,892	1,056.49	76.79	1,133.29	36.81	1.73
Darlington	68,681	561.15	5.65	566.80	122.39	1.15
Dillon	32,062	404.87	1.72	406.59	79.19	2.15
Dorchester	136,555	573.23	2.57	575.81	238.22	-4.43
Edgefield	26,985	500.41	6.29	506.70	53.93	-2.94
Fairfield	23,956	686.28	23.60	709.88	34.91	1.35
Florence	136,885	799.96	3.76	803.73	171.11	-0.03
Georgetown	60,158	813.55	221.10	1,034.65	73.95	1.49
Greenville	451,225	785.12	9.75	794.87	574.72	-1.59
Greenwood	69,661	454.73	8.20	462.93	153.19	1.31
Hampton	21,090	559.90	2.81	562.71	37.67	-0.11
Horry	269,291	1,133.90	121.11	1,255.00	237.49	-0.85
Jasper	24,777	655.32	44.04	699.36	37.81	0.97
Kershaw	61,697	726.56	13.83	740.40	84.92	-2.25
Lancaster	76,652	549.16	5.96	555.12	139.58	-1.44
Laurens	66,537	713.80	10.04	723.84	93.22	1.82
Lee	19,220	410.18	1.05	411.23	46.86	2.04
Lexington	262,391	698.91	58.82	757.73	375.43	-3.18
Marion	33,062	489.23	4.91	494.14	67.58	2.52
Marlboro	28,933	479.67	5.60	485.27	60.32	1.00
McCormick	10,233	359.13	34.74	393.87	28.49	-1.23
Newberry	37,508	630.04	17.25	647.29	59.53	1.10
Oconee	74,273	626.33	47.18	673.51	118.58	-1.60
Orangeburg	92,501	1,106.10	21.80	1,127.90	83.63	1.08
Pickens	119,224	496.41	15.62	512.03	240.18	-3.09
Richland	384,504	757.07	14.64	771.71	507.89	-2.63
Saluda	19,875	452.78	9.04	461.82	43.90	2.96
Spartanburg	284,307	807.93	11.32	819.24	351.90	-1.01
Sumter	107,456	665.07	17.02	682.08	161.57	-0.81
Union	28,961	1,145.69	9.86	1,155.55	375.07	-4.72
Williamsburg	34,423	934.16	2.88	937.04	36.85	2.03
York	226,073	680.59	15.21	695.81	332.17	-3.23
Total	**4,625,364**	**31,147.64**	**1,979.09**	**33,126.74**	**6,869.20**	****-0.33**

Source: US Cenuse 2010, HVRI calculation

TABLE 4.A1.2—VALUE OF STATE-OWNED FACILTIES

County	Count	Total Building Value	Total Contents Value
Abbeville	8	$3,493,000	$34,000
Aiken	39	$75,405,000	$754,000
Allendale	22	$42,645,000	$426,000
Anderson	46	$59,326,000	$591,000
Bamberg	23	$19,982,000	$199,000
Barnwell	17	$5,179,000	$52,000
Beaufort	40	$30,467,000	$304,000
Berkeley	25	$27,872,000	$278,000
Calhoun	6	$2,201,000	$21,000
Charleston	230	$876,240,000	$8,762,000
Cherokee	14	$4,190,000	$40,000
Chester	8	$4,232,000	$42,000
Chesterfield	27	$14,388,000	$145,000
Clarendon	27	$55,820,000	$561,000
Colleton	17	$9,927,000	$100,000
Darlington	10	$8,879,000	$88,000
Dillon	5	$2,365,000	$23,000
Dorchester	32	$55,379,000	$553,000
Edgefield	26	$23,441,000	$235,000
Fairfield	5	$1,905,000	$19,000
Florence	115	$160,340,000	$1,600,000
Georgetown	14	$7,527,000	$75,000
Greenville	86	$181,194,000	$1,814,000
Greenwood	64	$119,270,000	$1,188,000
Hampton	14	$5,984,000	$59,000
Horry	67	$109,469,000	$1,092,000
Jasper	21	$55,593,000	$554,000
Kershaw	35	$50,992,000	$511,000
Lancaster	20	$20,889,000	$209,000
Laurens	46	$49,344,000	$497,000
Lee	22	$60,408,000	$604,000
Lexington	56	$53,278,000	$530,000
Marion	8	$5,569,000	$55,000
Marlboro	15	$37,216,000	$371,000
McCormick	57	$58,768,000	$588,000
Newberry	13	$7,379,000	$74,000
Oconee	19	$7,979,000	$81,000
Orangeburg	100	$152,861,000	$1,529,000
Pickens	219	$500,456,000	$5,006,000
Richland	581	$1,588,127,000	$15,878,000
Saluda	7	$2,145,000	$21,000
Spartanburg	104	$176,467,000	$1,770,000
Sumter	61	$64,103,000	$641,000
Union	13	$6,572,000	$66,000
Williamsburg	22	$16,380,000	$164,000
York	74	$215,727,000	$2,155,000
Total	**2480**	**$5,037,373,000**	**$50,359,000**

Source: SCEMD

B. HURRICANES AND TROPICAL STORMS

Hurricanes, typhoons, and cyclones, are names for powerful tropical storms in which winds rotate around a closed circulation of low-pressure. In North America and the eastern Pacific they are known as hurricanes, in Asia they are known as typhoons, and in Australia they are called cyclones. In the Northern Hemisphere, hurricane winds rotate in a counter-clockwise direction (clockwise in the Southern Hemisphere)[25].

Formation

The key energy source for a hurricane is the release of latent heat energy from condensation. This energy is found where there is a deep layer of warm water to fuel the system. Conditions for hurricane formation include warm waters, rotational force from the earth's spin (Coriolis effect), and the absence of vertical wind shear (stability in the lower atmosphere). Tropical disturbances that affect North America typically originate off the west coast of Africa. If the tropical disturbance lowers in pressure and starts to rotate around a low pressure center, it may turn into a tropical depression. Barometric pressure (measured in millibars or inches) continues to fall in the center as these storm systems develop in intensity. When sustained wind speeds reach 39 miles per hour, the system becomes a tropical storm and is given a name by the National Hurricane Center. When sustained wind speeds reach 74 mph, it becomes a hurricane. Hurricanes are much larger and powerful storms with an average diameter of 350 miles. On average, approximately ten tropical storms are named and six become hurricane strength in the southeast region of United States. The start of the official Atlantic hurricane season is June 1st and ends November 30th. Peak hurricane season is August and September in the Northern Hemisphere, when water temperatures and evaporation rates are greatest. Associated with these storms are damaging winds, heavy precipitation, and tornadoes. Coastal areas are also vulnerable to storm surge, wind-driven waves, and tidal flooding, which can cause more destruction than cyclone winds.

Classification

Hurricane intensity is classified by the Saffir-Simpson Scale (**Table 4.B.1**), which categorizes hurricane intensity based upon maximum sustained wind speeds on a scale of 1 to 5, with 5 being the most intense. Typically, higher category hurricanes have lower pressure and greater storm surge. Categories 3, 4, and 5 are classified as "major" hurricanes, and while hurricanes within this range comprise only 20 percent of total landfalls, they account for over 70 percent of the damage in the United States.

Hurricane Hugo, one of the strongest hurricanes to hit South Carolina, made landfall as a Category 4 at the Isle of Palms around midnight on September 21, 1989. Hugo had sustained winds of 140 mph and wind gusts of over 160 mph. Hugo is the costliest storm in South Carolina's history, causing $7 billion in damages overall and resulting in 20 fatalities in the state. Based on this event, a Category 4 hurricane is the maximum intensity the South Carolina Emergency Management Division (SCEMD) anticipates for planning purposes.

TABLE 4.B.1—SAFFIR-SIMPSON SCALE

Category	Maximum Sustained Wind Speed (MPH)
1	74-95
2	96-110
3	111-130
4	131-155
5	>155

Source: NHC

Storm Surge

Storm Surge is elevated water level that is pushed towards the shore by the force of strong winds that result in the piling up of water. The advancing surge combines with the normal tides, which in extreme cases can increase the normal water height over 20 feet. The storm surge arrives ahead of the storm's actual landfall and the more intense the hurricane is, the sooner the surge arrives. Water rise can be very rapid and can move far inland, posing a serious threat to those who have not yet evacuated flood-prone areas. Debris carried by the waves can also contribute to the devastation. As the storm approaches shore, the greatest storm surge will be to the north of the hurricane eye, in the right-front quadrant of the direction in which the hurricane is moving. Such a surge of high water topped by waves driven by hurricane force winds can be devastating to coastal regions, causing severe beach erosion and property damage along the immediate coast. Storm surge heights, and associated waves, are dependent upon the shape of the continental shelf (narrow or wide) and the depth of the ocean bottom (bathymetry). A narrow shelf, or one that drops steeply from the shoreline and subsequently produces deep water close to the shoreline, tends to produce a lower surge but higher and more powerful storm waves. While disassociated with the Saffir-Simpson Scale, storm surge remains the leading killer of residents along immediate coastal areas.

In order to analyze the potential impact of storm surge on coastal counties, the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model was used to estimate storm surge heights from historical, hypothetical, and predicted hurricanes[26] (**Figure 4.B.1**). GIS analysis was conducted using census block population data (aggregated to the county level) from Hazus-MH, in conjunction with SLOSH data, to model population exposure to storm surge zones (**Table 4.B.2**). GIS analysis was also conducted to analyze state-owned facility exposure to storm surge with the SLOSH data (**Table 4.B.3**).

TABLE 4.B.2—COASTAL POPULATION EXPOSURE TO STORM SURGE

County	Population Exposed				
	CAT 5	CAT 4	CAT 3	CAT 2	CAT 1
Beaufort	112,985	104,639	84,613	56,345	33,046
Berkeley	26,003	14,641	9,776	5,261	1,258
Charleston	275,222	250,571	221,404	162,999	55,169
Colleton	7,351	6,063	3,990	2,345	1,105
Georgetow	44,570	41,095	28,548	10,813	4,847
Horry	111,178	92,852	38,622	13,835	5,878
Jasper	10,066	9,864	7,364	3,467	1,079

Source: Census 2010 & 2011 SC Hurricane Evacuation Study

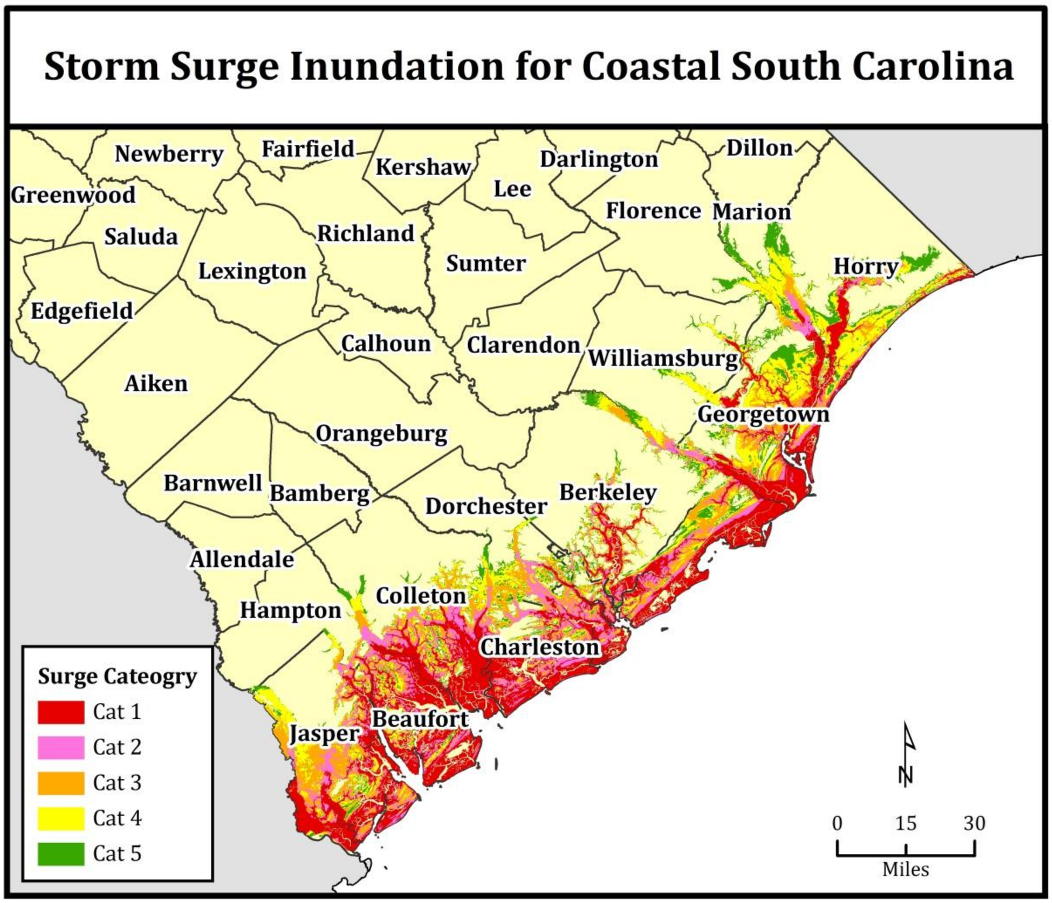


FIGURE 4.B.1—COASTAL STORM SURGE INUNDATION

TABLE 4.B.3—EXPOSURE OF STATE FACILITIES TO STORM SURGE IN COASTAL COUNTIES

County	Building Value				
	CAT 5	CAT 4	CAT 3	CAT 2	CAT 1
Beaufort	$5,593,000	$5,593,000	$3,988,000	$3,988,000	$2,437,000
Berkeley	$9,056,000	$9,056,000	$9,056,000	$6,428,000	$3,214,000
Charleston	$861,333,000	$851,084,000	$851,084,000	$841,775,000	$666,266,000
Colleton	$209,000	$209,000	$209,000	$209,000	$209,000
Georgetown	$7,527,000	$7,527,000	$6,426,000	$299,000	$0
Horry	$3,718,000	$3,601,000	$751,000	$751,000	$751,000
Jasper	$495,000	$495,000	$0	$0	$0

Source: Hazus-MH & 2011 SC Hurricane Evacuation Study

Wind

Hurricane winds can cause widespread destruction; even tropical storm-force winds can be very dangerous. Such high winds can pick up debris and turn them into dangerous missile-like objects, knock down trees and buildings, and destroy mobile homes. The Saffir-Simpson Scale categorizes hurricane intensity based on sustained wind speeds and correlated potential property damage[27].

Heavy Rain

Hurricanes are capable of generating great amounts of rainfall. Rainfall rates are related to the size and strength of the hurricane; slower moving and large storms tend to generate more rain[28]. Hurricane Isaac in 2012, being both large and slow-moving, caused rainfall rates of 1 to 2 inches per hour in some locations, which created dangerous flood conditions even after the storm was downgraded from a hurricane to a tropical storm[29].

Tornadoes

Hurricanes and tropical storms may spawn tornadoes that are typically further out from the center of the system; generally embedded in the rain bands. Hurricane-spawned tornadoes also generally have a shorter lifespan but can still cause great damage[30].

Location

Although hurricanes make landfall in the coastal areas, all counties in South Carolina have experienced damage from hurricanes. Some of the most destructive hurricanes and tropical storms have originated in the Gulf of Mexico or traveled around the tip of Florida, impacting in the upstate region. For example, Hurricane Frances hit the upstate in 2004 with enough damage to warrant a Presidential Disaster Declaration.

Historical and Notable Events

Great Sea Island Storm of 1893 (August 27–28, 1893): One of the deadliest hurricanes to strike the United States, this storm made landfall in Georgia at high tide bringing a tremendous storm surge that created a “tidal wave” effect that swept over and submerged whole islands. The storm’s north-northeast track through the South Carolina midlands brought wind speeds between 96 mph and 125 mph, with maximum winds of 125 mph in the Beaufort area, and up to 120 mph in

Charleston. Major damages were reported as the storm moved north near Columbia and then northeast through the rest of the state, causing between 2,000 and 2,500 deaths, an estimated $10 million in damages, and leaving 20,000 to 30,000 survivors homeless.

Hurricane Hazel (October 15, 1954): Hazel made landfall as a Category 3 hurricane near Little River, bringing storm surge up to 16.9 feet. One fatality and approximately $27 million in damages were reported. Hurricane Hazel is considered one of the most severe storms to hit South Carolina to date.

Hurricane Gracie (September 29, 1959): Category 3 hurricane Gracie made landfall at St. Helena Island with winds of 140 mph, moving northwest before weakening to a tropical storm as it passed through Columbia and turned north-northwest on a path into North Carolina. Storm surge reached nearly six feet above normal tides. Several fatalities, as well as property damage, were reported along the southern coastal area. Heavy crop damage occurred, and moderate to heavy flooding was reported due to six to eight inches of rainfall.

Hurricane Hugo (September 21, 1989): Hugo, a Category 4 hurricane made landfall at Isle of Palms with sustained winds of 140 mph and wind gusts exceeding 160 mph. Hugo is the costliest storm in South Carolina history, causing over $7 billion in damages to property and crops in the United States and the first major hurricane to strike the state since Gracie in 1959. Total damages, including those that occurred in Puerto Rico and the Caribbean, exceeded 10 billion dollars. Hurricane Hugo resulted in 35 storm-related fatalities, 20 of which occurred in South Carolina. Seven of the South Carolina fatalities occurred in mobile home parks northwest of Charleston. The strongest winds passed over the Francis Marion National Forest between Bulls Bay and the Santee River. The Forest Service estimated that timber losses exceeded $100 million. While the most severe winds occurred to the northeast of Charleston, the city was hard hit. The Charleston City Hall and a fire station lost their roofs and over 4,000 historic properties were damaged. Coastal storm surge reached 20 feet in some areas, making it the highest ever recorded in the state. Folly Beach was among the most significantly impacted coastal communities. Approximately 80 percent of the homes were destroyed. Sullivan's Island and the Isle of Palms were also severely damaged. Numerous homes were knocked off their foundations and boats in the local marina were tossed into a 50 foot tall pile of debris. Severe inland wind damage occurred as winds gusting to 109 mph at Sumter were reported. The hurricane exited the state just north of Rock Hill, causing significant damage in Charlotte, North Carolina. South Carolina received a Presidential Disaster Declaration for this event.

Hurricane Fran (September 5, 1996): Although Hurricane Fran skirted the South Carolina coast before making landfall at the entrance of the Cape Fear River in North Carolina, it triggered the evacuation of 500,000 tourists in the coastal areas of both states. Wind gusts of 60 mph were reported along the Horry County coast. In Georgetown County, 57 mph winds in the City of Georgetown contributed to $150,000 in county government infrastructure damage. Eleven evacuation shelters housed 5,400 people. One death was attributed to the storm. In Horry County, agricultural losses of $19.8 million were reported, with corn, tobacco and sweet potato crops hardest hit. Downed trees caused power outages affecting about 60,000 customers. Horry County reported property losses totaling over $1 million, including $448,000 at North Myrtle Beach, $341,000 at Myrtle Beach, $42,000 at Surfside Beach, $46,000 at Garden City Beach, and $135,000 in unincorporated areas. South Carolina received a Presidential Disaster Declaration for this event.

Hurricane Floyd (September 15, 1999): Hurricane Floyd weakened to a Category 3 hurricane as it approached the southern South Carolina coast on the morning of September 15th. The storm skirted the coast, its center moving northeast about 60 miles offshore late in the afternoon and early evening as it took a north and northeast course toward North Carolina. Sustained winds of tropical storm force were reported from Savannah, Georgia to Charleston, with wind gusting to hurricane force strength in the Charleston area. The highest recorded sustained wind speed was 58 mph in downtown Charleston, with gusts reaching 85 mph. Rainfall was heavy along coastal counties as 12 inches of rain fell in Georgetown County. A reported 18 inches fell in eastern Horry County, causing major flooding along the Waccamaw River in and around the City of Conway for a month. Waves were reported to be 15 feet at Cherry Grove Pier, where damage was the greatest. Minor to moderate beach erosion occurred along the South Carolina coast. Many businesses and homes suffered major damage, with thousands of homes experiencing at least some minor damage in Charleston County, causing approximately $10.5 million in damage. In Horry County, approximately 400 homes and numerous roads were inundated for over one month following the storm. Beaufort County reported $750,000 damage, and Berkeley and Dorchester counties reporting $500,000 each. Over 1,000 trees were blown down, knocking out power to over 200,000 customers across the southern coast. In Myrtle Beach, tree and sign damage was reported to reach approximately $250,000. In Williamsburg County, total damage estimates due to the high winds and rain reached approximately $650,000. In Florence County, high winds downed trees, caused power outages and resulted in $150,000 in property damages. Total estimated property damages for the affected counties totaled approximately $17 million. While Hurricane Floyd did not make landfall in South Carolina, it resulted in the largest peacetime evacuation in the state's history, surpassing Hurricane Fran. It is estimated that between 500,000 and one million people evacuated the coast. South Carolina received a Presidential Disaster Declaration for this event.

Hurricane Gaston (August 29, 2004): Gaston reached Category 1 sustained wind speeds before making landfall as a tropical storm near Awendaw, South Carolina[31]. The next day, Gaston weakened to a tropical depression in the northeastern portion of the state. Charleston and Georgetown Counties had voluntary evacuation issued for barrier islands, low-lying areas, beachfront areas, mobile homes, and other places that are prone to flooding. Localized flooding occurred from storm surge of roughly four feet. Peak wind gusts were recorded at 82 mph in Charleston and Isle of Palms. There were strong winds from this slow storm that knocked down trees, power lines, and caused major structural damage. Roughly 3000 structures were damaged from strong winds in Charleston, Berkeley, and Dorchester counties. An F1 tornado was reported in Marlboro County[32]. Property damage estimates for Charleston and Berkeley counties were estimated at $16.6 million dollars.

Tropical Storm Frances (September 6-7, 2004): Frances formed as a tropical storm on August 25 and reached hurricane force on the 26th, and eventually as high as a Category 4 hurricane on the 28th[33]. While crossing the Bahamas it weakened to a Category 2 and eventually was a tropical depression as it moved through Georgia and up the Southern Appalachians[34]. Significant for South Carolina were the tornado outbreaks from the remnants of Frances. Approximately 41 tornadoes were reported for South Carolina on the 7th, breaking the previous one-day record of 23 tornadoes on August 16, 1994 from Tropical Storm Beryl. Sumter County had the worst damage[35]. An F2 destroyed 9 homes, damaged 55 homes, injured 3 people, and caused over $1.7 million in damage. Kershaw County had an F3 tornado that destroyed several stables and picked up a horse trailer and dropped it onto the roof of another stable. Total loss estimates for the state were estimated at over $93 million dollars.

Recent Activity (2009 – 2011)

Hurricane Irene (August 27, 2011): Irene narrowly missed the state and made landfall on August 27 as a Category 1 hurricane in North Carolina. The day before landfall, Irene brought severe weather conditions that led to power outages, downed trees, and flood conditions reported for the coastal part of South Carolina. After landfall, Irene continued to track up the northeast coast causing storm surges, falling trees, and rainfall-induced flooding. Irene also spawned tornadoes in North Carolina, Virginia, New York, and Pennsylvania. Six deaths are attributed to Irene and total damage estimate is at $15.8 billion.

Vulnerability

The following section provides information on hazard vulnerability across South Carolina by county. Specifically, this section provides tables and maps to summarize historical and recent hurricane events and their associated losses (property damage, crop damage, fatalities, and injuries). The totals for these losses were calculated from the National Climatic Data Center (NCDC) Storm Events database, and the Spatial Hazard Events and Losses Database for the US (SHELDUS). Hazus-MH is also used to model impact from hurricane winds. Historical hurricane track data came from NOAA's International Best Track Archive for Climate Stewardship (IBTrACS).

Table 4.B.4 is a list of building inventory by type, listed for each county. Building types include residential, commercial, and other. The values in this table are used in later calculations for building exposure to specific hazard types. Hazus-MH uses this data to estimate loss and damage to buildings.

TABLE 4.B.4—BUILDING INVENTORY (values in thousands of dollars)

County	Residential	Commercial	Other	Total
Abbeville	$1,101,304	$130,403	$227,297	$1,459,004
Aiken	$6,666,043	$1,251,374	$649,921	$8,567,338
Allendale	$340,511	$54,803	$92,032	$487,346
Anderson	$7,460,105	$1,703,301	$1,209,665	$10,373,071
Bamberg	$588,573	$105,156	$88,703	$782,432
Barnwell	$820,282	$156,652	$160,898	$1,137,832
Beaufort	$7,519,827	$1,516,736	$489,915	$9,526,478
Berkeley	$5,761,510	$904,440	$578,113	$7,244,063
Calhoun	$572,187	$61,919	$67,208	$701,314
Charleston	$16,544,851	$4,558,966	$1,961,640	$23,065,457
Cherokee	$2,020,233	$396,825	$340,067	$2,757,125
Chester	$1,230,314	$228,580	$210,437	$1,669,331
Chesterfield	$1,487,957	$257,118	$314,243	$2,059,318
Clarendon	$1,177,269	$148,722	$120,466	$1,446,457
Colleton	$1,445,669	$310,637	$200,937	$1,957,243
Darlington	$2,391,962	$470,860	$464,839	$3,327,661
Dillon	$934,446	$191,052	$171,921	$1,297,419
Dorchester	$4,145,474	$686,811	$480,441	$5,312,726
Edgefield	$942,776	$150,897	$193,139	$1,286,812
Fairfield	$902,763	$124,090	$112,143	$1,138,996
Florence	$5,013,948	$1,636,444	$778,206	$7,428,598
Georgetown	$2,783,682	$623,797	$359,547	$3,767,026
Greenville	$18,900,063	$4,771,578	$2,902,067	$26,573,708
Greenwood	$2,985,477	$701,709	$522,362	$4,209,548
Hampton	$675,015	$134,237	$111,173	$920,425
Horry	$11,194,436	$2,670,351	$926,761	$14,791,548
Jasper	$666,462	$191,485	$90,319	$948,266
Kershaw	$2,286,885	$411,763	$257,403	$2,956,051
Lancaster	$2,395,372	$421,490	$434,503	$3,251,365
Laurens	$2,741,536	$398,819	$439,422	$3,579,777
Lee	$593,398	$93,469	$102,468	$789,335
Lexington	$10,715,250	$2,164,668	$1,197,181	$14,077,099
Marion	$1,086,274	$241,898	$219,868	$1,548,040
Marlboro	$909,198	$141,299	$176,640	$1,227,137
McCormick	$410,870	$41,721	$54,387	$506,978
Newberry	$1,591,494	$265,977	$218,734	$2,076,205
Oconee	$3,080,344	$516,473	$493,398	$4,090,215
Orangeburg	$3,457,533	$797,336	$591,261	$4,846,130
Pickens	$4,789,648	$919,083	$627,594	$6,336,325
Richland	$16,252,096	$3,926,844	$2,442,184	$22,621,124
Saluda	$850,744	$76,857	$99,974	$1,027,575
Spartanburg	$11,708,359	$2,912,055	$2,319,830	$16,940,244
Sumter	$3,958,667	$765,194	$720,814	$5,444,675
Union	$1,193,731	$178,864	$195,212	$1,567,807
Williamsburg	$1,075,626	$182,514	$147,750	$1,405,890
York	$7,660,726	$1,579,010	$1,228,497	$10,468,233
Total	**$183,030,890**	**$40,174,277**	**$25,791,580**	**$248,996,747**

Source: Hazus-MH

Table 4.B.5 provides a count of historical hurricane events from 1960 to 2011, and a recent count of events from 2009-2011, and their associated losses. Historically, Georgetown County has the highest annualized losses from hurricane events while Charleston and Horry Counties have the highest number of loss-causing recorded hurricane events. **Figure 4.B.2** shows the historical hurricane tracks from 1960 through 2008. At the time this document was written, no hurricane has made landfall in South Carolina since 2008.

Using the methods and data described in the previous section, maps of probabilistic 100-year and 500-year hurricane events were modeled for the state of South Carolina from Hazus. The 100-year event means there is a 1% chance of the event happening in any given year. The 500-year event means there is a 0.2% chance of the event happening in any given year. **Figure 4.B.3** and **Figure 4.B.4** are the resulting maps from the modeled probabilistic 100-year and 500-year hurricane events. These maps show potential peak wind gusts and a probable storm track for each event. As expected, the highest peak wind gusts will be felt along the South Carolina coast. In the 500-year model, high wind gusts will be felt further inland than the 100-year event. For these two hurricane events, Hazus also provides damage and loss estimates for buildings, essential facilities, debris generation, and shelter requirements. The values in parentheses **( )** are the model estimates for the 500-year event. Following the descriptions below, **Tables 4.B.6a-d** provide more detailed numbers to specific subcategories of losses for the 100-year hurricane, and **Tables 4.B.7a-d** provides detailed estimates for the 500-year hurricane.

Total economic loss for the 100-year hurricane event is estimated at $6,858,500,000 ($24,420,400,000) dollars.

Buildings: Hazus-MH estimates that there are 1,832,000 buildings in the state with a total replacement value of $248,996,000,000 (2006 $). According to the results of this analysis, 72,360 (231,199) buildings will sustain at least moderate damage. The total number of buildings expected to have damage beyond repair is 4,197 (32,978). The following **Table 4.B.6a (Table 4.B.7a)** summarizes expected damage based on general building type. **Table 4.B.6b (Table 4.B.7b)** provides detail on direct building losses and income losses. Direct building losses are the estimated costs to repair or replace the damage and income losses result from the inability to continue business operations because of sustained damages. **Table 4.B.6d** and **Table 4.B.7d** gives the estimated total building losses (for all occupancy types) at the county level for the 100 and 500-year events. Hazus-MH provides an estimated loss ratio for building economic losses. Using this loss ratio and the total value of all buildings, an estimated loss total for all buildings by county is provided for the 100- and 500-year hurricane wind events.

Essential Facilities: Hazus provides estimated damage to essential facilities **(Table 4.B.6c, Table 4.B.7c),** which include hospitals, schools, police and fire stations, and emergency operations facilities (EOC). Before the earthquake, the state had 14,840 hospital beds. The model estimates that 11,793 (6,914) hospital beds remain available in use. After one week, 81% (51%) will be available for use, and by 30 days, 91% (80%) will be operational.

Debris: The model estimates that 9,866,985 (28,979,823) tons of debris will be generated, with 48% (55%) comprised of brick and wood debris and the remainder being reinforced concrete, steel, and 'eligible' tree debris. The model also indicates that it will require 31,691 (115,163) truckloads to remove the debris.

Shelter: Hazus estimates the number of households who are expected to be displaced from their homes and will require temporary public shelters for this earthquake event. The model estimates that 11,744 (75,447) households will be displaced and 2,967 (20,461) people will seek temporary shelter.

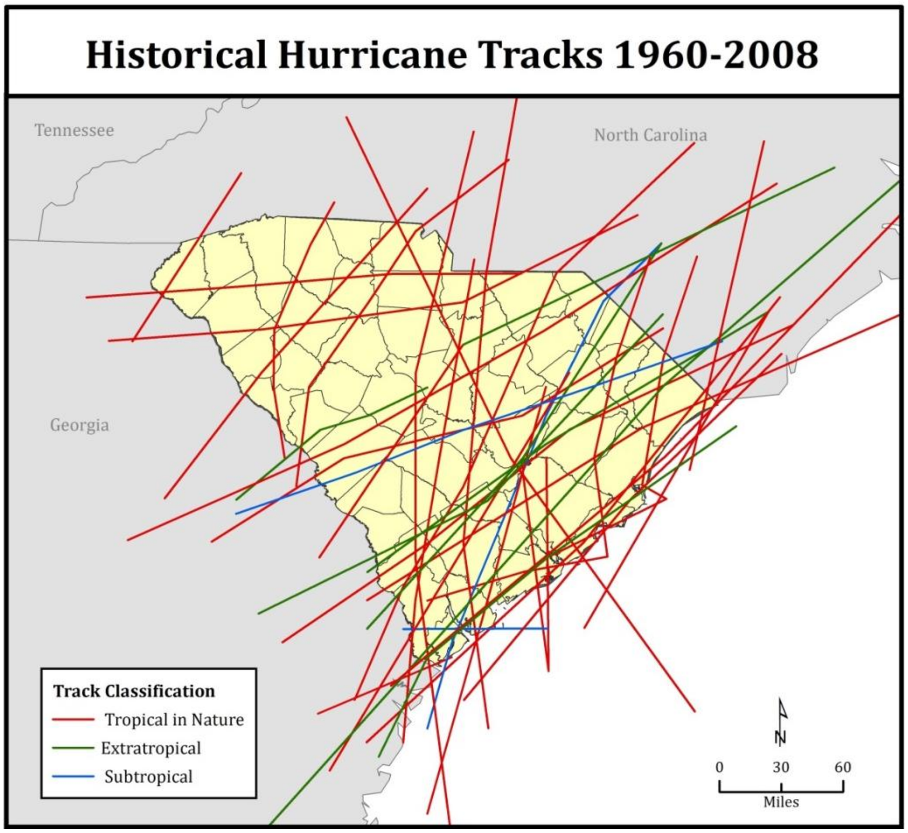


FIGURE 4.B.2—HISTORICAL HURRICANE TRACKS

TABLE 4.B.5—HISTORICAL AND RECENT HURRICANE EVENTS AND LOSSES

County	HISTORICAL EVENTS (1960-2011)								RECENT EVENTS (2009-2011)					
	Future Probability (% chance per year)	Frequency Interval	Annualized Losses	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Deaths	Injuries	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Recorded Crop Damage	Deaths	Injuries
CHARLESTON	55.77	1.79	$19,329,977	29	17	$914,771,776	2	0	1	1	$21,000	$0	0	0
BERKELEY	57.69	1.73	$19,326,072	30	15	$101,412,634	6	8	1	1	$1,000	$0	0	0
GEORGETOWN	48.08	2.08	$19,223,215	25	14	$909,220,145	0	2	0	0	$0	$0	0	0
HORRY	46.15	2.17	$18,295,974	24	17	$913,278,409	1	2	0	0	$0	$0	0	0
SUMTER	50.00	2.00	$13,919,989	26	7	$362,414,975	1	328	0	0	$0	$0	0	0
DORCHESTER	55.77	1.79	$13,426,149	29	12	$580,679,736	0	12	0	0	$0	$0	0	0
WILLIAMSBURG	57.69	1.73	$11,163,179	30	11	$123,457,733	0	0	0	0	$0	$0	0	0
YORK	21.15	4.73	$7,233,138	11	6	$363,453,117	0	0	0	0	$0	$0	0	0
LANCASTER	32.69	3.06	$4,315,847	17	6	$134,052,240	0	0	0	0	$0	$0	0	0
KERSHAW	42.31	2.36	$4,228,120	22	7	$165,630,764	0	0	0	0	$0	$0	0	0
CLARENDON	55.77	1.79	$3,494,888	29	7	$91,362,343	0	2	0	0	$0	$0	0	0
LEE	48.08	2.08	$3,494,888	25	7	$91,362,343	1	20	0	0	$0	$0	0	0
FLORENCE	59.62	1.68	$3,490,507	31	9	$91,125,158	0	0	0	0	$0	$0	0	0
DARLINGTON	50.00	2.00	$3,316,755	26	9	$126,181,299	0	0	0	0	$0	$0	0	0
RICHLAND	48.08	2.08	$1,757,371	25	7	$49,800,940	1	30	0	0	$0	$0	0	0
ORANGEBURG	59.62	1.68	$1,270,866	31	7	$57,029,010	1	20	0	0	$0	$0	0	0
CHESTERFIELD	42.31	2.36	$952,692	22	8	$16,983,318	0	0	0	0	$0	$0	0	0
CALHOUN	44.23	2.26	$714,861	23	7	$13,660,589	0	0	0	0	$0	$0	0	0
DILLON	46.15	2.17	$362,977	24	9	$9,809,369	0	0	0	0	$0	$0	0	0
CHESTER	26.92	3.71	$354,309	14	6	$9,368,029	0	0	0	0	$0	$0	0	0
COLLETON	55.77	1.79	$339,390	29	16	$4,917,809	2	0	0	0	$0	$0	0	0
BEAUFORT	48.08	2.08	$264,790	25	15	$13,732,896	0	0	0	0	$0	$0	0	0
FAIRFIELD	30.77	3.25	$210,981	16	7	$1,914,975	0	0	0	0	$0	$0	0	0
MARION	50.00	2.00	$209,682	26	11	$1,835,107	0	0	0	0	$0	$0	0	0
MARLBORO	40.38	2.48	$206,600	21	9	$9,809,369	0	0	0	0	$0	$0	0	0
BARNWELL	38.46	2.60	$107,164	20	6	$5,551,608	0	0	0	0	$0	$0	0	0
JASPER	44.23	2.26	$85,034	23	13	$4,397,535	0	0	0	0	$0	$0	0	0
HAMPTON	50.00	2.00	$75,238	26	9	$3,891,421	0	0	0	0	$0	$0	0	0
ALLENDALE	46.15	2.17	$62,189	24	6	$3,212,876	0	0	0	0	$0	$0	0	0
MCCORMICK	19.23	5.20	$62,074	10	5	$3,209,896	0	0	0	0	$0	$0	0	0
CHEROKEE	19.23	5.20	$24,240	10	5	$1,233,470	0	0	0	0	$0	$0	0	0
LEXINGTON	46.15	2.17	$21,765	24	7	$1,020,501	0	0	0	0	$0	$0	0	0
BAMBERG	48.08	2.08	$20,045	25	7	$1,020,501	0	0	0	0	$0	$0	0	0
NEWBERRY	28.85	3.47	$19,739	15	5	$1,008,486	0	0	0	0	$0	$0	0	0
SALUDA	25.00	4.00	$19,739	13	5	$1,008,486	0	0	0	0	$0	$0	0	0
GREENVILLE	13.46	7.43	$7,038	7	5	$338,997	0	0	0	0	$0	$0	0	0
LAURENS	19.23	5.20	$7,038	10	5	$338,997	0	0	0	0	$0	$0	0	0
SPARTANBURG	17.31	5.78	$7,038	9	5	$338,997	0	0	0	0	$0	$0	0	0
UNION	23.08	4.33	$7,038	12	5	$338,997	0	0	0	0	$0	$0	0	0
AIKEN	36.54	2.74	$6,805	19	5	$332,942	0	0	0	0	$0	$0	0	0
ABBEVILLE	15.38	6.50	$6,691	8	4	$329,961	0	0	0	0	$0	$0	0	0
ANDERSON	11.54	8.67	$6,691	6	4	$329,961	0	0	0	0	$0	$0	0	0
EDGEFIELD	21.15	4.73	$6,691	11	4	$329,961	0	0	0	0	$0	$0	0	0
GREENWOOD	21.15	4.73	$6,691	11	4	$329,961	0	0	0	0	$0	$0	0	0
OCONEE	9.62	10.40	$6,691	5	4	$329,961	0	0	0	0	$0	$0	0	0
PICKENS	9.62	10.40	$6,691	5	4	$329,961	0	0	0	0	$0	$0	0	0
Grand Total	**1,736.54**	**158.90**	**$151,475,546**	**903**	**363**	**$5,186,487,560**	**15**	**423**	**2**	**2**	**$22,000**	**$0**	**0**	**0**

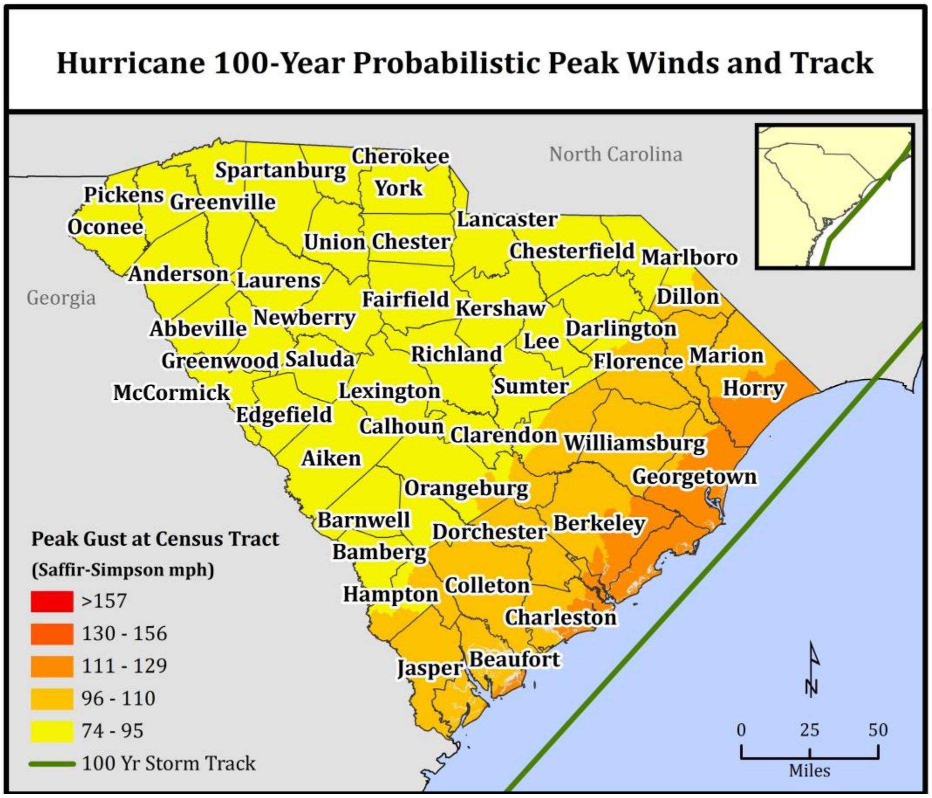


FIGURE 4.B.3—100-YEAR HURRICANE WINDS AND TRACK

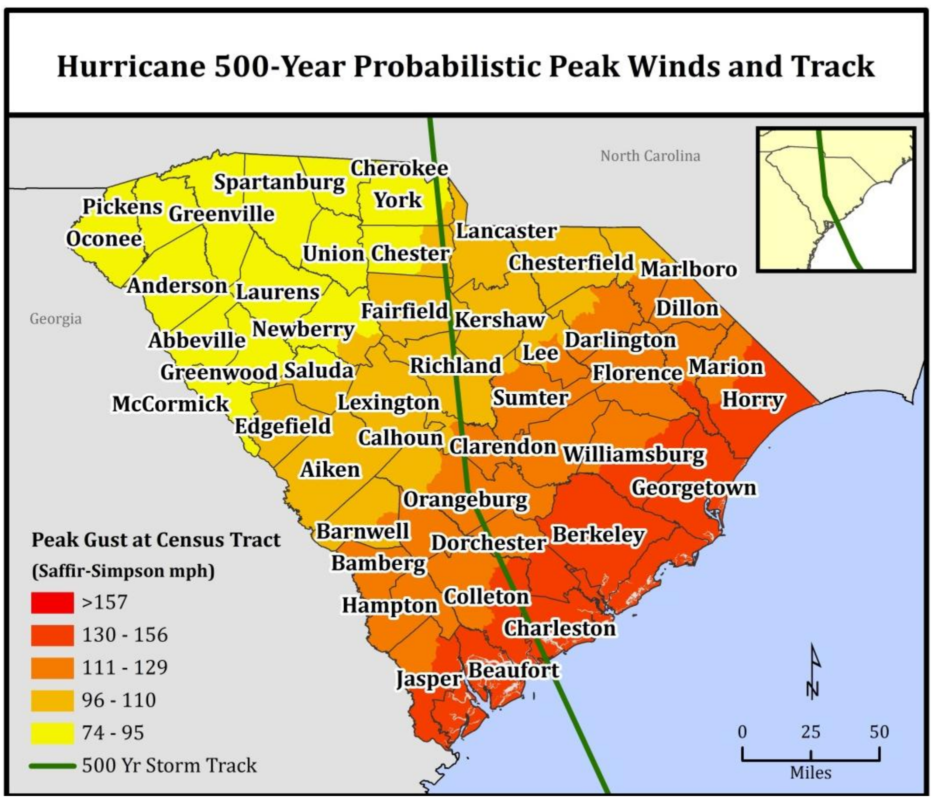


FIGURE 4.B.4—500-YEAR HURRICANE WINDS AND TRACK

TABLE 4.B.6a—100-YEAR HURRICANE BUILDING DAMAGE BY BUILDING OCCUPANCY

	None		Slight		Moderate		Extensive		Complete	
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	5,566	88.00	419	6.63	205	3.24	113	1.79	22	0.35
Commercial	76,591	87.20	5,319	6.06	4,451	5.07	1,441	1.64	32	0.04
Education	2,671	89.76	157	5.26	109	3.65	40	1.33	0	0.00
Government	2,783	91.43	130	4.26	95	3.11	36	1.19	0	0.00
Industrial	23,253	88.56	1,453	5.53	1,079	4.11	454	1.73	20	0.08
Residential	1,505,155	88.74	127,076	7.49	51,638	3.04	8,110	0.48	4,124	0.24
Religion	9,371	90.52	589	5.69	301	2.91	91	0.88	0	0.00
Total	**1,625,390**		**135,143**		**57,878**		**10,285**		**4,198**	

Source: Hazus-MH

TABLE 4.B.7a—500-YEAR HURRICANE BUILDING DAMAGE BY BUILDING OCCUPANCY

	None		Slight		Moderate		Extensive		Complete	
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	4,721	76.64	671	10.61	486	7.69	348	5.51	98	1.56
Commercial	65,522	74.60	7,699	8.77	8,387	9.55	5,988	6.82	238	0.27
Education	2,175	73.07	298	10.01	280	9.42	222	7.47	1	0.02
Government	2,186	71.83	322	10.57	306	10.07	229	7.53	0	0.01
Industrial	19,928	75.89	2,102	8.00	2,143	8.16	1,963	7.47	124	0.47
Residential	1,275,961	75.23	211,111	12.45	129,119	7.61	47,400	2.79	35,512	1.92
Religion	7,900	76.31	1,098	10.60	828	8.00	522	5.04	4	0.04
Total	**1,378,393**		**223,301**		**141,549**		**56,672**		**35,977**	

Source: Hazus-MH

TABLE 4.B.6b—100-YEAR HURRICANE BUILDING LOSS (values in thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Other	Total
Property Damage	Structural	$3,495,769	$438,387	$80,029	$70,826	$4,085,011
	Content	$1,289,572	$230,635	$55,906	$34,908	$1,611,022
	Inventory	$0	$7,910	$12,720	$967	$21,597
	Subtotal	$4,785,341	$676,933	$148,654	$106,701	$5,717,629
Business Loss	Income	$8,040	$70,456	$1,456	$3,824	$83,776
	Relocation	$499,729	$120,201	$9,494	$21,478	$650,902
	Rental	$228,320	$66,869	$1,335	$2,330	$298,855
	Wage	$18,951	$67,817	$2,379	$18,160	$107,307
	Subtotal	$755,041	$325,343	$14,664	$45,792	$1,140,840
TOTAL		**$5,540,381**	**$1,002,276**	**$163,319**	**$152,493**	**$6,858,469**

Source: Hazus-MH

TABLE 4.B.7b—500-YEAR HURRICANE BUILDING LOSS (values in thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Other	Total
Property Damage	Structural	$11,405,557	$1,606,127	$477,961	$360,054	$13,849,700
	Content	$4,694,646	$1,031,052	$411,424	$215,766	$6,352,888
	Inventory	$0	$35,332	$94,611	$4,078	$134,020
	Subtotal	$16,100,203	$2,672,511	$983,996	$579,898	$20,336,608
Business Loss	Income	$20,383	$371,783	$11,478	$10,634	$414,278
	Relocation	$1,726,156	$385,719	$41,922	$101,623	$2,255,419
	Rental	$644,323	$230,632	$8,362	$13,001	$896,318
	Wage	$48,034	$403,120	$18,664	$48,001	$517,819
	Subtotal	$2,438,897	$1,391,254	$80,426	$173,258	$4,083,835
TOTAL		**$18,539,100**	**$4,063,765**	**$1,064,422**	**$753,156**	**$24,420,443**

Source: Hazus-MH

TABLE 4.B.6c—100-YEAR HURRICANE ESSENTIAL FACILITY DAMAGE

Classification	Total	At Least Moderate Damage >50%	Complete Damage >50%	Expected Loss of Use <1 Day
Hospitals	108	19	4	88
Schools	1,550	102	0	1,203
EOCs	47	0	0	47
Police Stations	205	205	3	204
Fire Stations	482	0	0	47

Source: Hazus-MH

TABLE 4.B.7c—500-YEAR HURRICANE ESSENTIAL FACILITY DAMAGE

Classification	Total	At Least Moderate Damage >50%	Complete Damage >50%	Expected Loss of Use <1 Day
Hospitals	108	45	6	62
Schools	1,550	367	0	838
EOCs	47	5	0	45
Police Stations	205	23	0	196
Fire Stations	482	58	0	481

Source: Hazus-MH

TABLE 4.B.6d—100-YEAR HURRICANE COUNTY TOTAL BUILDING LOSSES (values in thousands of dollars)

County	Total	Loss Ratio	Total Building Losses 100
Abbeville	$1,459,004	0.00	$0
Aiken	$8,567,338	0.00	$0
Allendale	$487,346	0.03	$13,824
Anderson	$10,373,071	0.00	$0
Bamberg	$782,432	0.04	$29,208
Barnwell	$1,137,832	0.01	$6,433
Beaufort	$9,526,478	6.41	$61,076,469
Berkeley	$7,244,063	3.40	$24,612,846
Calhoun	$701,314	0.02	$10,898
Charleston	$23,065,457	8.07	$186,245,713
Cherokee	$2,757,125	0.00	$0
Chester	$1,669,331	0.00	$0
Chesterfield	$2,059,318	0.00	$6,253
Clarendon	$1,446,457	0.24	$345,641
Colleton	$1,957,243	1.34	$2,626,842
Darlington	$3,327,661	0.02	$73,988
Dillon	$1,297,419	0.25	$326,339
Dorchester	$5,312,726	2.68	$14,262,961
Edgefield	$1,286,812	0.00	$0
Fairfield	$1,138,996	0.00	$0
Florence	$7,428,598	0.20	$1,461,565
Georgetown	$3,767,026	6.22	$23,414,281
Greenville	$26,573,708	0.00	$0
Greenwood	$4,209,548	0.00	$0
Hampton	$920,425	0.29	$266,099
Horry	$14,791,548	6.00	$88,773,825
Jasper	$948,266	1.78	$1,691,116
Kershaw	$2,956,051	0.00	$0
Lancaster	$3,251,365	0.00	$0
Laurens	$3,579,777	0.00	$0
Lee	$789,335	0.01	$9,077
Lexington	$14,077,099	0.00	$0
Marion	$1,548,040	0.72	$1,108,775
Marlboro	$1,227,137	0.03	$34,033
McCormick	$506,978	0.00	$0
Newberry	$2,076,205	0.00	$0
Oconee	$4,090,215	0.00	$0
Orangeburg	$4,846,130	0.09	$421,110
Pickens	$6,336,325	0.00	$0
Richland	$22,621,124	0.00	$1,617
Saluda	$1,027,575	0.00	$0
Spartanburg	$16,940,244	0.00	$0
Sumter	$5,444,675	0.03	$145,754
Union	$1,567,807	0.00	$0
Williamsburg	$1,405,890	1.09	$1,536,402
York	$10,468,233	0.00	$0
Total	**$248,996,747**	**39**	**$408,501,070**

Source: Hazus-MH

TABLE 4.B.7d—500-YEAR HURRICANE COUNTY TOTAL BUILDING LOSSES **(values in thousands of dollars)**

County	Total	Loss Ratio	Total Building Loss 500
Abbeville	$1,459,004	0.00	$0
Aiken	$8,567,338	0.08	$683,944
Allendale	$487,346	0.62	$303,256
Anderson	$10,373,071	0.00	$0
Bamberg	$782,432	6.52	$5,098,157
Barnwell	$1,137,832	1.94	$2,208,410
Beaufort	$9,526,478	7.72	$73,498,063
Berkeley	$7,244,063	20.43	$147,978,414
Calhoun	$701,314	15.77	$11,057,644
Charleston	$23,065,457	26.51	$611,515,869
Cherokee	$2,757,125	0.04	$109,245
Chester	$1,669,331	1.01	$1,693,362
Chesterfield	$2,059,318	1.94	$3,988,396
Clarendon	$1,446,457	10.18	$14,728,086
Colleton	$1,957,243	16.97	$33,217,491
Darlington	$3,327,661	0.86	$2,868,046
Dillon	$1,297,419	0.07	$86,393
Dorchester	$5,312,726	29.61	$157,286,411
Edgefield	$1,286,812	0.01	$7,024
Fairfield	$1,138,996	1.69	$1,923,443
Florence	$7,428,598	0.35	$2,566,216
Georgetown	$3,767,026	0.06	$238,917
Greenville	$26,573,708	0.00	$0
Greenwood	$4,209,548	0.00	$0
Hampton	$920,425	3.93	$3,618,543
Horry	$14,791,548	0.01	$204,011
Jasper	$948,266	1.31	$1,237,869
Kershaw	$2,956,051	7.83	$23,134,850
Lancaster	$3,251,365	4.34	$14,125,187
Laurens	$3,579,777	0.00	$6,463
Lee	$789,335	4.84	$3,817,702
Lexington	$14,077,099	2.10	$29,498,060
Marion	$1,548,040	0.06	$96,227
Marlboro	$1,227,137	0.19	$234,258
McCormick	$506,978	0.00	$0
Newberry	$2,076,205	0.21	$433,819
Oconee	$4,090,215	0.00	$0
Orangeburg	$4,846,130	15.50	$75,108,491
Pickens	$6,336,325	0.00	$0
Richland	$22,621,124	4.33	$97,894,129
Saluda	$1,027,575	0.08	$79,459
Spartanburg	$16,940,244	0.00	$14,915
Sumter	$5,444,675	9.58	$52,139,941
Union	$1,567,807	0.07	$109,158
Williamsburg	$1,405,890	0.53	$745,768
York	$10,468,233	1.09	$11,414,359
Total	**$248,996,747**	**$198**	**$1,384,969,996**

Source: Hazus-MH

C. COASTAL

The South Carolina Coastal Management Program was established in 1979 under the guidelines of the national Coastal Zone Management Act of 1972. Prior to the establishment of the South Carolina Coastal Management Program, the South Carolina General Assembly passed the South Carolina Tidelands and Wetlands Act (SCTWA) to oversee the protection, development, use, and enhancement of the State's coastal resources. Under the Act, a state-level management agency known as the South Carolina Coastal Council (SCCC) was established. This agency has jurisdiction over the state's beaches and other "critical areas" in the coastal zone (8 coastal counties). The coastal program is now administered by the Department of Health and Environmental Control's Office of Ocean and Coastal Resource Management (DHEC-OCRM).

From 1977 to 1988, permits to armor the shorelines with bulkheads, seawalls, and revetments were granted by the SCCC on a regular basis and property owners were allowed to build large commercial structures immediately landward of the sand dune line. Recognizing that the state law did not give the SCCC the jurisdictional authority to adequately protect the state's beaches and dune systems and because there was growing concern that the recreational beach were being lost, the South Carolina General Assembly passed the Beachfront Management Act in 1988. The Beachfront Management Act gave the SCCC additional regulatory authority over oceanfront property and established a beach-monitoring program. This monitoring program collects beach and near-shore profiles once per year. **Table 4.C.1** provides a list of beach renourishment projects permitted by DHEC-OCRM since 1977 along the coast of South Carolina.

TABLE 4.C.1—BEACH RENOURISHMENT PROJECTS (values in millions of dollars)

Project/Year	Local Cost	Private Cost	State Cost	Federal Cost	Total Cost
Hilton Head Island 2012	$10	$0	$0	$0	$10
Isle of Palms - Wild Dunes 2008	$3	$7	$1	$0	$11
Myrtle Beach 2008	$0	$0	$0	$0	$18
North Myrtle Beach 2008	$0	$0	$0	$0	$10
Surfside Beach/Garden City Beach 2008	$0	$0	$0	$0	$11
Folly Beach 2007	$0	$0	$0	$8	$8
Hilton Head Island 2007	$19	$0	$0	$0	$19
Debidue Beach 2006	$0	$6	$0	$0	$6
Edisto Beach 2006	$3	$0	$5	$0	$8
Hunting Island 2006	$0	$0	$9	$0	$9
Folly Beach 2005	$1	$0	$0	$12	$13
Hilton Head Island 1999	$1	$0	$0	$0	$1
Daufuskie Island 1998	$0	$6	$0	$0	$6
Debidue Beach 1998	$0	$2	$0	$0	$2
Pawleys Island 1998	$0	$0	$1	$0	$1
Sullivans Island 1998	$0	$0	$0	$0	$0
Hilton Head Island 1997	$11	$0	$0	$0	$11
Myrtle Beach 1996	$0	$0	$0	$0	$17
North Myrtle Beach 1996	$0	$0	$0	$0	$20
Surfside Beach/Garden City Beach 1996	$0	$0	$0	$0	$14
Edisto Beach 1995	$1	$0	$1	$0	$2
Folly Beach 1993	$0	$0	$4	$12	$15
Hunting Island 1991	$0	$0	$3	$0	$3
Debidue Beach 1990	$0	$1	$0	$0	$1
Hilton Head Island 1990	$2	$0	$8	$0	$10
Seabrook Island 1990	$0	$2	$0	$0	$2
Myrtle Beach 1986	$5	$0	$0	$0	$5

Source: SC DHEC-OCRM

South Carolina's coast is subject to a variety of coastal hazards, including coastal storms, long-term sea level rise, erosion, and saltwater intrusion[36]. Other coastal hazards include flooding, tsunamis, and land subsidence[37]. Development and human settlement puts lives and properties at risk to these coastal hazards. **Table 4.C.2** lists historical and recent coastal hazard events and losses by county. **Figure 4.C.1** and **Figure 4.C.2** show by county, the number of coastal events, and property losses from coastal hazards from 2009-2011.

Erosion

Erosion is a process that breaks down and wears away land due to physical and chemical processes of water, wind, and general meteorological conditions. An area's potential for erosion is determined by four factors: soil characteristics, vegetative cover, climate or rainfall, and topography. The two major erosion mechanisms are wind and water. Wind that blows across sparsely vegetated or disturbed lands can cause erosion by picking up soil, carrying it through the air, and displacing it in another place. Water erosion occurs over land, and in streams and channels. Major storms can cause coastal erosion from the combination of high winds and heavy surf and storm surge. Human interactions, such as construction and development in coastal and riparian regions, can also exacerbate erosion.

DHEC-OCRM revises long-term beach erosion rates, as well as the state's beachfront baseline and 40 year set back line every eight to ten years. This process was recently completed (early 2010), and the updated rates and beachfront jurisdictional line maps can be found at: http://www.scdhec.gov/environment/ocrm/permit_beachfront.htm. Based on this analysis of shoreline changes since the mid-1800s, and other independent researchers, South Carolina's beaches appear to be experiencing net erosion in general, but beach renourishment has been keeping pace with this underlying trend in most cases. Long-term shoreline change rates, (as shown in **Figure 4.C.3a, b**) varies from marginally accretional along some standard beaches, to highly erosional (as much as 20 feet per year) in some highly dynamic inlet areas. Beginning with Hurricane Irene in 2011, Folly Beach in Charleston County has experienced above average erosion rates and is considered one of the most vulnerable beaches in South Carolina.

Location

Eight of the 46 counties in South Carolina are located along the Atlantic coast, making the especially vulnerable to hurricanes, sea level rise, erosion, salt water intrusion, and other coastal events. Coastal events can also have inland-reaching impacts; in particular, the inland counties of Williamsburg, Orangeburg, and Florence have historically been affected by hurricanes and coastal storms.

Vulnerability

The following section provides information on hazard vulnerability across South Carolina by county. Specifically, this section provides tables and maps to summarize historical and recent coastal hazard events and their associated losses (property damage, crop damage, fatalities, and injuries). The totals for these losses were calculated from the National Climatic Data Center (NCDC) Storm Events database, and the Spatial Hazard Events and Losses Database for the US (SHELDUS). The coastal erosion data in **Figures 4.C.3a** and **4.C.3b** comes from Department of Health and Environmental Control's Office of Ocean and Coastal Resource Management (DHEC-OCRM). This dataset represents true long-term erosion rates, not event specific data.

TABLE 4.C.2—HISTORICAL AND RECENT COASTAL EVENTS AND LOSSES

County	HISTORICAL EVENTS (1960-2011)								RECENT EVENTS (2009-2011)					
	Future Probability (% chance per year)	Frequency Interval	Annualized Losses	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Deaths	Injuries	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Recorded Crop Damage	Deaths	Injuries
CHARLESTON	94.23	1.06	$17,530,328	49	15	$909,925,732	2	0	21	2	$202,360	$0	0	0
HORRY	38.46	2.60	$1,806,182	20	16	$92,702,003	14	7	5	2	$0	$0	6	3
GEORGETOWN	34.62	2.89	$1,787,369	18	14	$92,702,003	7	0	2	0	$0	$0	0	0
BEAUFORT	50.00	2.00	$222,868	26	13	$11,461,929	0	0	5	0	$0	$0	0	0
SPARTANBURG	1.92	52.00	$142,038	1	1	$6,085	0	0	0	0	$0	$0	0	0
COLLETON	46.15	2.17	$133,858	24	14	$6,846,085	1	1	5	2	$15,000	$0	1	1
JASPER	13.46	7.43	$113,308	7	11	$5,777,491	0	0	0	0	$0	$0	0	0
SALUDA	1.92	52.00	$55,779	1	1	$6,085	0	0	0	0	$0	$0	0	0
KERSHAW	1.92	52.00	$50,949	1	1	$6,085	0	0	0	0	$0	$0	0	0
FAIRFIELD	1.92	52.00	$44,974	1	1	$6,085	0	0	0	0	$0	$0	0	0
BERKELEY	19.23	5.20	$30,156	10	10	$1,291,664	0	0	0	1	$2,060	$0	0	0
CHEROKEE	1.92	52.00	$24,003	1	1	$6,085	0	0	0	0	$0	$0	0	0
DILLON	1.92	52.00	$21,188	1	1	$6,085	0	0	0	0	$0	$0	0	0
NEWBERRY	1.92	52.00	$20,525	1	1	$6,085	0	0	0	0	$0	$0	0	0
MARION	3.85	26.00	$18,254	2	2	$298,035	0	0	1	0	$0	$0	0	0
FLORENCE	3.85	26.00	$17,978	2	1	$6,085	0	0	1	0	$0	$0	0	0
MARLBORO	3.85	26.00	$16,650	2	1	$6,085	0	0	1	0	$0	$0	0	0
EDGEFIELD	1.92	52.00	$16,635	1	1	$6,085	0	0	0	0	$0	$0	0	0
WILLIAMSBURG	3.85	26.00	$13,797	2	2	$298,035	0	0	1	0	$0	$0	0	0
LANCASTER	1.92	52.00	$12,671	1	1	$6,085	0	0	0	0	$0	$0	0	0
DARLINGTON	3.85	26.00	$12,355	2	1	$6,085	0	0	1	0	$0	$0	0	0
DORCHESTER	3.85	26.00	$11,863	2	2	$298,035	0	0	0	0	$0	$0	0	0
GREENVILLE	1.92	52.00	$11,860	1	1	$6,085	0	0	0	0	$0	$0	0	0
CHESTERFIELD	1.92	52.00	$11,273	1	1	$6,085	0	0	0	0	$0	$0	0	0
PICKENS	1.92	52.00	$9,789	1	1	$6,085	0	0	0	0	$0	$0	0	0
OCONEE	1.92	52.00	$9,709	1	1	$6,085	0	0	0	0	$0	$0	0	0
SUMTER	1.92	52.00	$9,252	1	1	$6,085	0	0	0	0	$0	$0	0	0
LAURENS	1.92	52.00	$9,030	1	1	$6,085	0	0	0	0	$0	$0	0	0
ANDERSON	1.92	52.00	$8,271	1	1	$6,085	0	0	0	0	$0	$0	0	0
CLARENDON	1.92	52.00	$8,175	1	1	$6,085	0	0	0	0	$0	$0	0	0
CALHOUN	1.92	52.00	$6,681	1	1	$6,085	0	0	0	0	$0	$0	0	0
GREENWOOD	1.92	52.00	$6,657	1	1	$6,085	0	0	0	0	$0	$0	0	0
ORANGEBURG	1.92	52.00	$6,521	1	1	$6,085	0	0	0	0	$0	$0	0	0
LEE	1.92	52.00	$6,350	1	1	$6,085	0	0	0	0	$0	$0	0	0
AIKEN	1.92	52.00	$6,251	1	1	$6,085	0	0	0	0	$0	$0	0	0
BAMBERG	1.92	52.00	$5,410	1	1	$6,085	0	0	0	0	$0	$0	0	0
RICHLAND	1.92	52.00	$4,993	1	1	$6,085	0	0	0	0	$0	$0	0	0
YORK	1.92	52.00	$4,942	1	1	$6,085	0	0	0	0	$0	$0	0	0
ABBEVILLE	1.92	52.00	$4,887	1	1	$6,085	0	0	0	0	$0	$0	0	0
CHESTER	1.92	52.00	$4,812	1	1	$6,085	0	0	0	0	$0	$0	0	0
UNION	3.85	26.00	$4,798	2	1	$6,085	0	0	0	0	$0	$0	0	0
LEXINGTON	3.85	26.00	$4,711	2	1	$6,085	0	0	0	0	$0	$0	0	0
MCCORMICK	1.92	52.00	$4,609	1	1	$6,085	0	0	0	0	$0	$0	0	0
BARNWELL	1.92	52.00	$4,422	1	1	$6,085	0	0	0	0	$0	$0	0	0
HAMPTON	1.92	52.00	$3,026	1	1	$6,085	0	0	0	0	$0	$0	0	0
ALLENDALE	1.92	52.00	$2,146	1	1	$6,085	0	0	0	0	$0	$0	0	0
Grand Total	**386.54**	**1,843.35**	**$22,262,303**	**201**	**135**	**$1,121,820,056**	**25.08002**	**8**	**43**	**7**	**$219,420**	**$0**	**7**	**4**

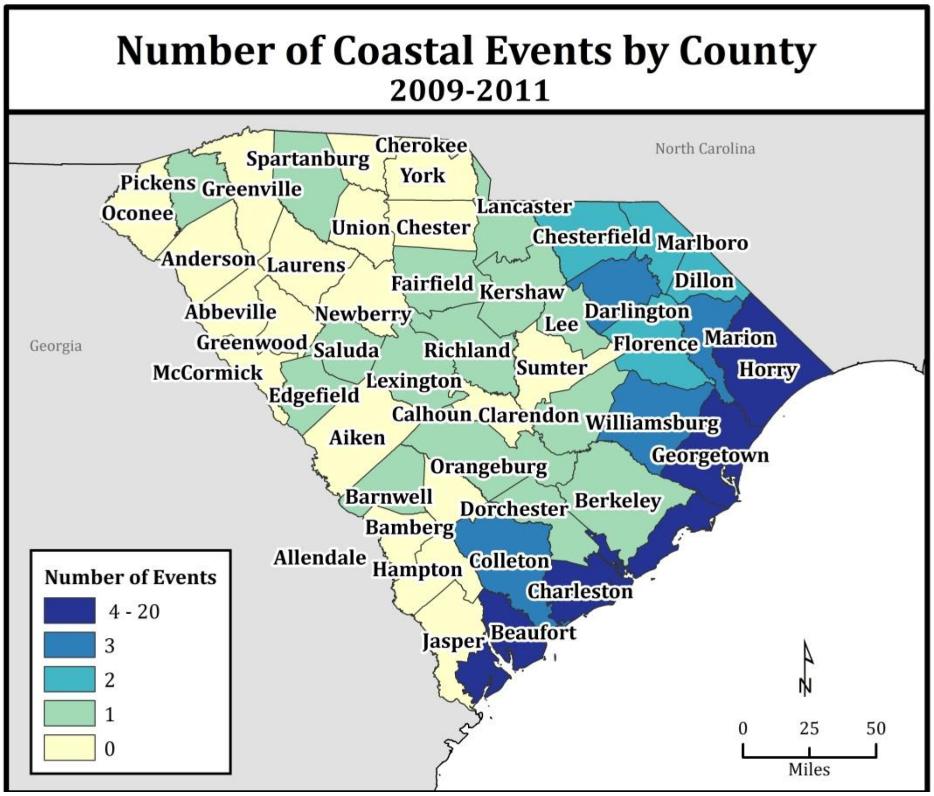


FIGURE 4.2.1—TOTAL COASTAL HAZARD EVENTS

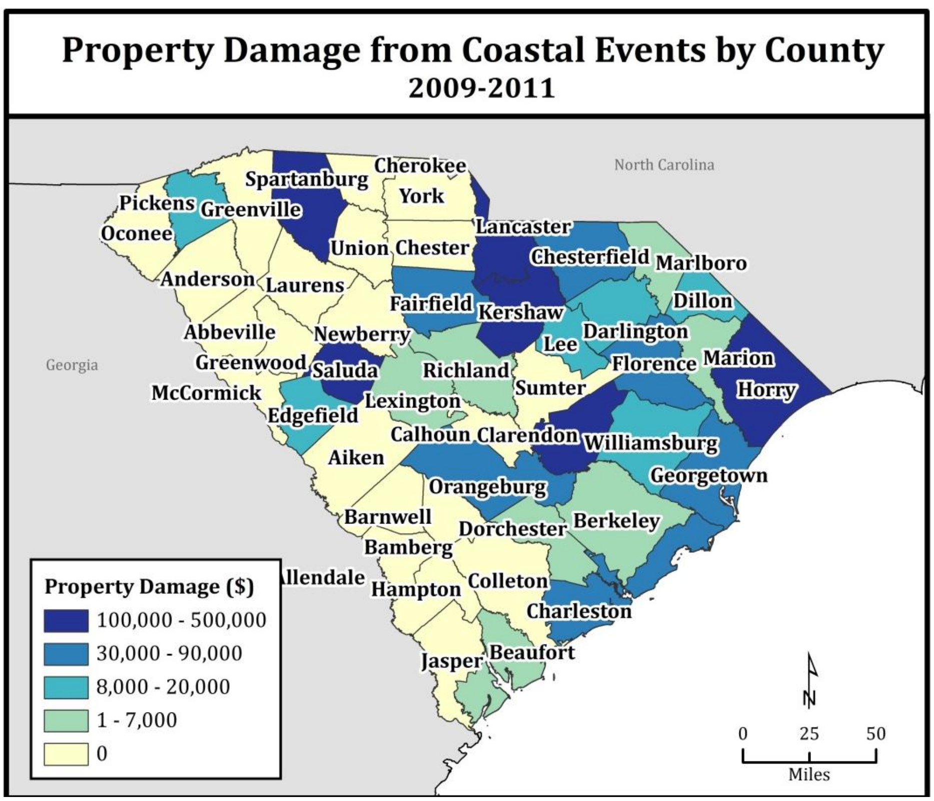


FIGURE 4.2.2—TOTAL COASTAL HAZARD LOSSES

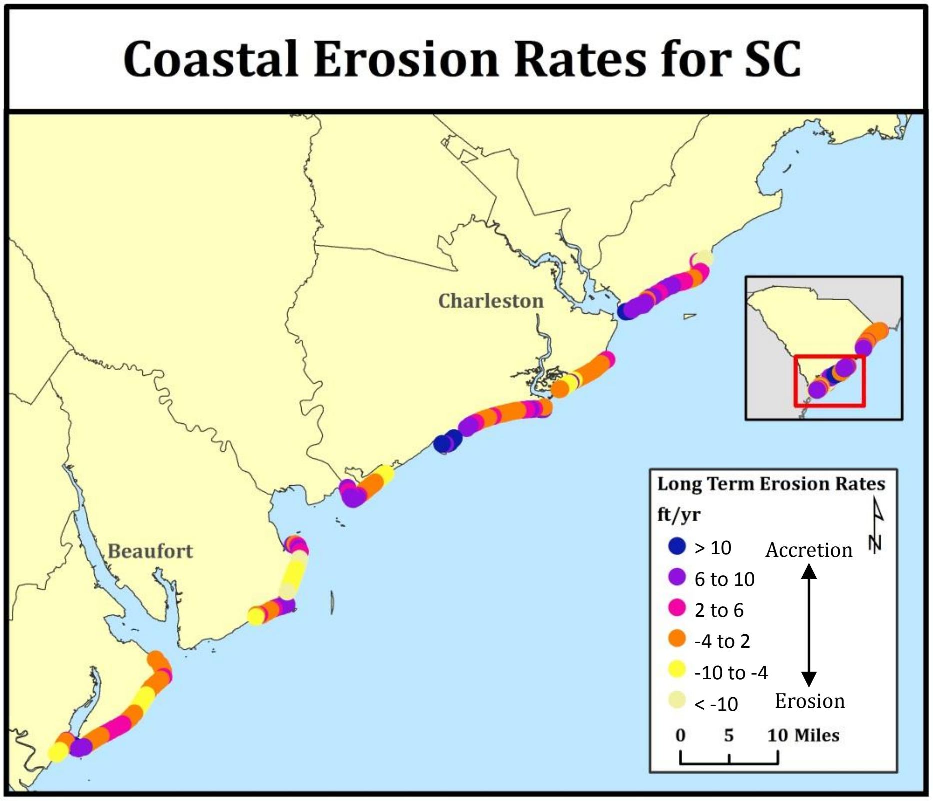


FIGURE 4.C.3a—EROSION RATE FOR SOUTHERN SOUTH CAROLINA'S COAST

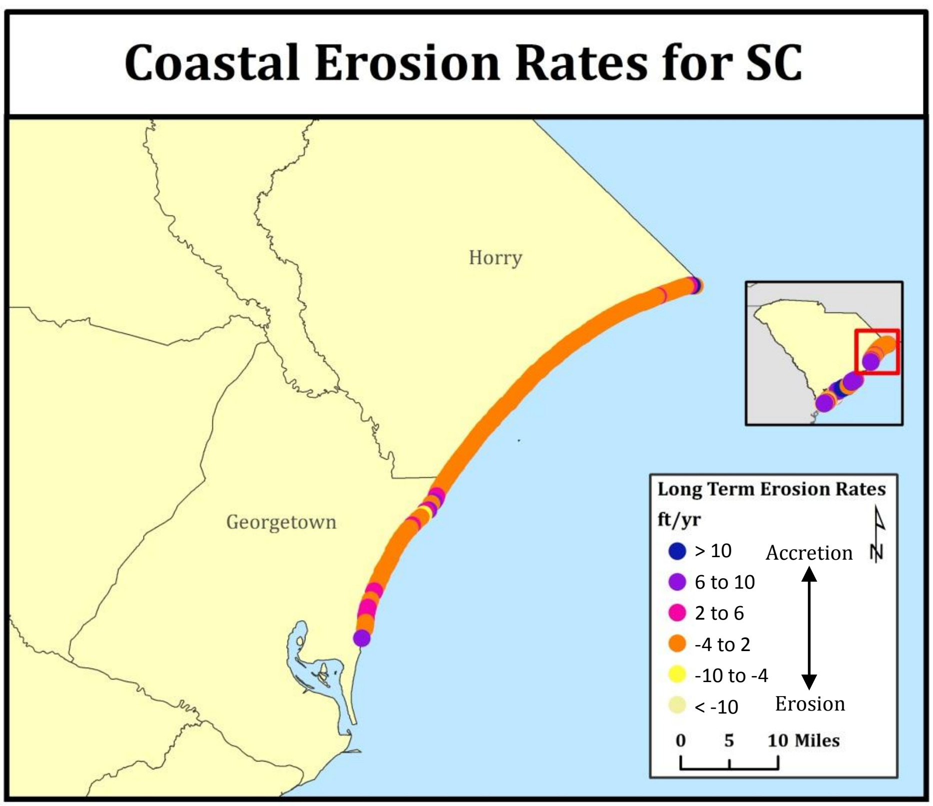


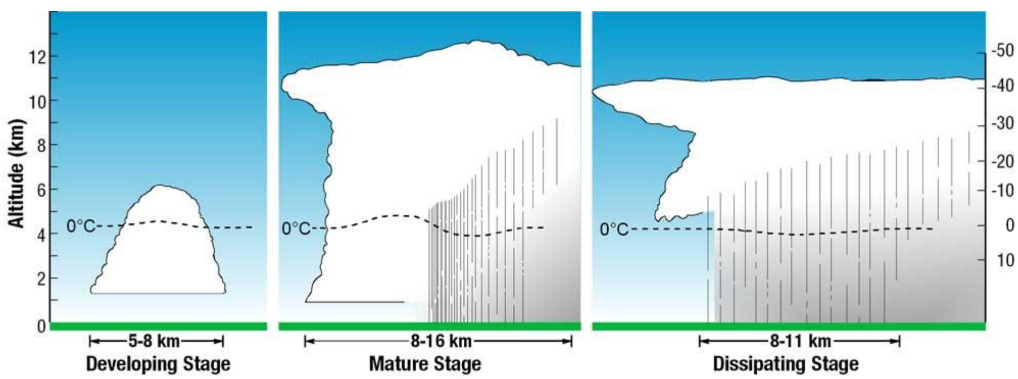
FIGURE 4.C.3b—EROSION RATE FOR NORTHERN SOUTH CAROLINA'S COAST

D. SEVERE THUNDERSTORMS AND LIGHTNING

A thunderstorm is a rainstorm event during which thunder is heard, which is audible due to lightning causing the air to heat and expand rapidly. Therefore, all thunderstorms have lightning[38]. According to the National Weather Service, there are approximately 100,000 thunderstorms that occur in the United States per year and about 25 million lighting flashes a year, killing about 69 people annually[39]. This number reflects the significant decline in fatalities within the past few decades, but lightning continues to remain a top storm-related killer. While thunderstorms can occur in all regions of the United States, they are most common in the central and southern regions because atmospheric conditions there are most ideal for generating these storms.

Formation

Thunderstorm and severe storm formation requires high moisture content, rising warm and unstable air (or strong temperature lapse rate), a lifting mechanism, and wind shear (a change in wind speed and direction with height). Conditions favorable for severe thunderstorm formation generally occur over a large area, and storms typically appear in clusters or a line of multiple storm cells (squall line)(3). Thunderstorm formation is generally classified into three stages:



Source: http://www.nssl.noaa.gov/pri 1

The **developing** or cumulus stage is when unstable air rises, and clouds undergo vertical growth. There is little rain at this stage and because of the lifting mechanism, either by localized convection or some other trigger, clouds can grow vertically of 5 to 20 meters per second. Within the cloud the temperature decreases with height and ice crystals start to form. Lightning may occur during this relatively short-lived stage.

The **mature stage** occurs when precipitation begins to fall. Downdrafts (columns of downward-pushed air) form in the most intense precipitation areas, with updrafts in the center that continue to feed the storm water vapor. Precipitation, lightning, and thunder are most intense during the mature stage.

The **dissipating stage** occurs when precipitation becomes heavy enough and occupies the entire cloud base, the updraft is overcome by the downdraft and the additional moist air is cut off from feeding the storm. Precipitation decreases in intensity at this stage.

Lightning first requires a regional separation of positive and negative charges within a cloud. The surrounding air acts as an insulator between these charges. Cloud-to-cloud or cloud-to-ground lighting occurs when the differences (voltage gradient) between the charges overpowers the insulating properties of the air.

Classification

A thunderstorm is classified as severe when at least one of the following occurs: wind speeds exceed 58 miles per hour, tornadoes spawn, or when hail exceeds 0.75 inches in diameter[40]. In the United States, about 10% of yearly thunderstorm events are classified as severe. Severe thunderstorms can also occur from supercells. A **supercell** is unique from other storms because it contains a single persistent rotating updraft zone, or a single cell rather than multiple cells in a system. A supercell storm can last up to several hours[41], is immensely powerful, and typically have the conditions to spawn violent tornadoes.

Mesoscale convective complexes (MCCs) are circular and typically occur, and are most intense at night. MCCs generally consist of several isolated thunderstorms. The primary threats from these complexes are heavy rain and flooding[42]. A Squall line is the term used to identify a line of active thunderstorms.

Lightning can cause injury and death. If thunder can be heard, lightning is present, and the best way to protect against lightning is to avoid it. The National Weather Service advises people to find an enclosed building to shelter in, while staying away from electronics, showers, sinks, and bathtubs. Fully enclosed automobiles are relatively safe because if it is struck, the electricity will flow around the outside of the car.

Location

Thunderstorms can occur in all regions of the United States but are most common in the central and southern states. It cannot be predicted where thunderstorms may occur, therefore it is assumed in this plan that all buildings and facilities are considered to be equally exposed to these to hazards and could be impacted.

Historical and Notable Events

March 15, 1996: A squall line raced across Upstate South Carolina, impacting numerous counties. Across the region, downed trees and power lines as well as roof and sign damage was reported. At the Donaldson Center Industrial Air Park in Greenville County, wind equipment at the Lockheed facility measured 75 knot winds, and trees and power lines were downed around the former Air Force base. It was estimated that this storm caused one death, seven injuries, and approximately $100,000 in damages.

September 12, 1997: Myrtle Beach experienced a thunderstorm microburst which brought heavy rains. The hardest hit area was the beach berm and hotel area along a four block strip from 26th Avenue to 30th Avenue. Two people were injured, sustaining cuts and bruises from flying glass and debris. Damages were estimated at $500,000.

April 24, 1999: Strong to severe thunderstorms developed just ahead of a cold front moving south through the Upstate. One particular storm became very severe in the southern part of Greenville County, then moved into Laurens County and caused a considerable amount of damage. Widespread damage caused by both very large hail and straight line winds occurred in the Mountville and Cross Hill vicinities. Damages were estimated at $250,000.

August 16, 2003: A microburst caused damage to 12 airplanes and 3 hangars at the Greenville Municipal Airport. One plane was blown approximately 300 feet into the side of a hangar, causing the plane to break in half. Three single-engine planes were flipped over. A concrete block wall was also blown over. The total event cost about $300,000 in property damage.

August 12, 2004: An intense downburst at Fort Jackson in Richland County associated with a squall line did moderate damage to several facilities on the base. The strong winds caused aluminum bleachers to become projected missiles and wrap around nearby telephone poles. Three injuries were reported as well as $300,000 in property damage.

Recent Activity (2009 – 2011)

February 28, 2009: Lightning from a thunderstorm struck a house and caused a fire in McCormick County. Property damage was estimated to be at $200,000.

June 1, 2009: Lightning struck a home in Murrells Inlet that created a fire that destroyed the home. Property damage was estimated to be at $400,000.

July 26, 2010: Severe thunderstorms in Richland County produced microburst with wind gust up to 80mph, knocking down trees and power lines. A home was destroyed from a fire caused by lightning. Property damage from this storm is estimated at $230,000.

April 9, 2011: Severe thunderstorms produced lightning, which struck the Centenary Baptist Church. Property damage was estimated at $300,000.

Vulnerability

The following section provides information on hazard vulnerability across South Carolina by county. Specifically, this section provides tables and maps to summarize historical and recent severe storm events (**Figure 4.D.1**) and lightning events (**Figure 4.D.3**) and their associated losses (**Figure 4.D.2, 4.D.4**) (property damage, crop damage, fatalities, and injuries). The totals for these losses were calculated from the National Climatic Data Center (NCDC) Storm Events database, and SHELDUS.

Historically, Greenville has had the greatest number of loss-causing severe storm events (**Table 4.D.1**) and Spartanburg has the greatest number of loss-causing lightning events (**Table 4.D.2**).

TABLE 4.D.1—HISTORICAL AND RECENT SEVERE STORM EVENTS AND LOSSES

County	HISTORICAL EVENTS (1960-2011)								RECENT EVENTS (2009-2011)					
	Future Probability (% chance per year)	Frequency Interval	Annualized Losses	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Deaths	Injuries	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Recorded Crop Damage	Deaths	Injuries
MARLBORO	213.46	0.47	$1,765,286	111	37	$1,067,905	0	3	17	3	$129,448	$0	0	1
FLORENCE	334.62	0.30	$348,103	174	36	$17,623,747	0	5	72	3	$163,511	$0	0	1
SPARTANBURG	778.85	0.13	$236,862	405	45	$9,325,928	2	5	40	2	$7,778	$0	0	0
LEE	192.31	0.52	$220,488	100	28	$1,670,320	0	1	8	3	$55,497	$0	0	0
HORRY	369.23	0.27	$177,697	192	41	$5,052,343	1	9	52	3	$284,923	$0	0	0
RICHLAND	582.69	0.17	$158,771	303	38	$7,480,911	4	12	36	3	$864,270	$0	0	2
GREENVILLE	734.62	0.14	$125,440	382	47	$5,382,034	3	11	4	1	$0	$0	0	1
LAURENS	519.23	0.19	$116,276	270	39	$4,662,041	1	3	3	1	$688,418	$0	1	0
PICKENS	448.08	0.22	$114,995	233	38	$4,852,392	1	3	10	2	$10,510	$0	0	1
OCONEE	438.46	0.23	$105,573	228	38	$4,365,127	0	1	9	0	$0	$0	0	0
CHARLESTON	398.08	0.25	$88,717	207	34	$2,497,114	2	3	38	3	$69,300	$1,000	0	0
ANDERSON	717.31	0.14	$78,013	373	46	$3,041,567	2	14	5	3	$188,658	$0	0	4
GEORGETOWN	226.92	0.44	$75,094	118	29	$3,501,442	1	1	29	3	$45,673	$0	0	1
COLLETON	334.62	0.30	$60,796	174	29	$2,008,287	0	3	7	3	$67,108	$2,000	0	0
KERSHAW	315.38	0.32	$59,381	164	30	$2,326,519	1	7	24	3	$151,507	$0	0	0
CHEROKEE	382.69	0.26	$57,912	199	38	$1,205,796	0	2	37	3	$25,855	$0	0	1
BEAUFORT	236.54	0.42	$56,881	123	31	$1,795,564	0	8	11	3	$124,890	$2,500	0	1
BERKELEY	340.38	0.29	$54,048	177	31	$1,604,555	2	6	12	3	$73,809	$1,000	0	0
ORANGEBURG	496.15	0.20	$49,445	258	32	$1,801,493	1	10	66	3	$179,950	$1,577	0	0
AIKEN	469.23	0.21	$48,706	244	30	$1,780,062	3	5	15	3	$550,854	$0	0	0
CALHOUN	228.85	0.44	$45,374	119	27	$1,598,196	0	0	12	3	$123,337	$0	0	0
YORK	465.38	0.21	$44,362	242	41	$1,538,006	2	7	2	2	$25,750	$0	0	1
LEXINGTON	667.31	0.15	$43,859	347	38	$1,481,701	3	9	10	3	$335,409	$0	0	0
JASPER	163.46	0.61	$43,309	85	28	$1,102,597	1	2	6	3	$49,575	$0	0	0
SUMTER	365.38	0.27	$41,877	190	36	$1,402,211	2	3	3	3	$180,854	$0	0	0
DARLINGTON	298.08	0.34	$41,006	155	39	$1,682,713	0	4	5	3	$135,187	$515	0	1
DORCHESTER	278.85	0.36	$39,848	145	30	$899,832	3	4	8	3	$56,999	$500	0	0
WILLIAMSBURG	163.46	0.61	$37,556	85	29	$1,154,956	1	2	3	3	$46,051	$0	0	0
CHESTERFIELD	234.62	0.43	$37,181	122	28	$1,632,238	0	6	12	3	$140,492	$0	0	3
BARNWELL	217.31	0.46	$36,657	113	24	$1,152,781	0	2	6	3	$80,413	$0	0	0
BAMBERG	230.77	0.43	$35,683	120	28	$686,193	0	1	10	3	$70,061	$0	0	0
DILLON	211.54	0.47	$35,674	110	31	$883,136	2	2	7	3	$51,724	$0	0	0
LANCASTER	230.77	0.43	$35,006	120	31	$1,065,801	0	4	4	3	$485,165	$1,030	0	0
UNION	338.46	0.30	$32,883	176	30	$949,997	0	2	0	0	$0	$0	0	0
CLARENDON	284.62	0.35	$31,327	148	27	$866,082	2	1	5	3	$203,084	$0	0	0
CHESTER	296.15	0.34	$31,251	154	36	$860,903	2	4	4	0	$0	$0	0	0
ALLENDALE	128.85	0.78	$31,225	67	25	$531,767	0	0	67	3	$78,962	$500	0	0
ABBEVILLE	269.23	0.37	$29,312	140	30	$738,816	0	4	22	0	$0	$0	0	0
MARION	192.31	0.52	$29,042	100	32	$1,012,909	0	1	41	3	$62,401	$0	0	0
NEWBERRY	303.85	0.33	$28,796	158	30	$743,848	0	0	21	3	$145,612	$0	0	0
FAIRFIELD	253.85	0.39	$26,598	132	27	$629,613	0	1	4	3	$69,900	$0	0	0
SALUDA	230.77	0.43	$26,315	120	27	$608,402	0	1	4	3	$199,316	$11,540	0	0
GREENWOOD	380.77	0.26	$24,197	198	34	$918,239	1	1	10	1	$26,276	$0	0	0
EDGEFIELD	188.46	0.53	$23,511	98	23	$882,102	1	2	9	3	$320,717	$1,545	0	0
HAMPTON	148.08	0.68	$21,692	77	26	$445,172	1	1	7	3	$61,199	$0	0	0
MCCORMICK	148.08	0.68	$16,336	77	26	$510,404	0	1	43	3	$78,841	$0	0	0
Grand Total	**15448.08**	**16.65**	**$4,868,362**	**8,033**	**1,500**	**$109,023,765**	**44**	**176**	**820**	**117**	**$6,709,286**	**$23,707**	**1**	**14**

TABLE 4.D.2—HISTORICAL AND RECENT LIGHTNING EVENTS AND LOSSES

County	HISTORICAL EVENTS (1960-2011)								RECENT EVENTS (2009-2011)					
	Future Probability (% chance per year)	Frequency Interval	Annualized Losses	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Deaths	Injuries	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Recorded Crop Damage	Deaths	Injuries
ANDERSON	65.38	1.53	$170,907	34	29	$8,745,208	0	15	6	2	$201,200	$0	0	2
CHARLESTON	59.62	1.68	$129,004	31	27	$6,615,301	7	18	3	2	$10,510	$0	0	2
RICHLAND	55.77	1.79	$97,365	29	29	$4,918,269	4	60	4	3	$993,635	$0	0	5
GREENVILLE	61.54	1.63	$75,499	32	30	$3,734,248	2	5	1	1	$210,204	$0	0	0
SPARTANBURG	71.15	1.41	$68,403	37	37	$2,864,562	6	24	2	2	$57,551	$0	0	0
BEAUFORT	76.92	1.30	$62,440	40	33	$3,215,957	8	29	2	2	$5,150	$0	0	1
FLORENCE	57.69	1.73	$49,542	30	26	$2,465,607	1	3	1	1	$5,000	$0	0	0
LEXINGTON	42.31	2.36	$43,075	22	22	$2,097,692	2	5	3	2	$172,200	$0	0	0
LAURENS	40.38	2.48	$42,749	21	21	$2,122,709	4	5	0	0	$0	$0	0	0
AIKEN	48.08	2.08	$37,329	25	23	$1,698,165	3	8	0	0	$0	$0	0	0
CHEROKEE	48.08	2.08	$36,652	25	24	$1,803,598	0	2	1	1	$10,510	$0	0	0
HORRY	63.46	1.58	$34,796	33	33	$1,713,715	8	14	6	2	$549,158	$0	0	0
OCONEE	48.08	2.08	$27,859	25	23	$1,151,446	3	8	1	1	$0	$0	0	2
ORANGEBURG	53.85	1.86	$26,897	28	26	$1,252,802	8	11	0	0	$0	$0	0	0
BAMBERG	32.69	3.06	$23,851	17	17	$1,090,779	1	2	0	0	$0	$0	0	0
YORK	53.85	1.86	$22,612	28	28	$1,029,924	4	9	1	1	$50,000	$0	0	0
COLLETON	36.54	2.74	$22,455	19	17	$1,138,971	2	2	1	1	$10,510	$0	0	0
GEORGETOWN	50.00	2.00	$21,029	26	25	$1,007,045	1	15	1	1	$5,255	$0	0	0
SUMTER	44.23	2.26	$20,449	23	22	$807,338	2	1	2	2	$103,816	$0	0	0
MARION	38.46	2.60	$19,709	20	18	$905,457	0	2	2	1	$300,000	$0	0	0
ALLENDALE	23.08	4.33	$16,488	12	12	$828,076	0	0	1	1	$15,450	$0	0	0
UNION	50.00	2.00	$16,253	26	24	$704,428	0	6	2	2	$47,296	$0	0	1
ABBEVILLE	34.62	2.89	$15,324	18	15	$721,031	1	1	0	0	$0	$0	0	0
CLARENDON	32.69	3.06	$13,609	17	16	$457,863	6	7	0	0	$0	$0	0	0
BERKELEY	40.38	2.48	$13,238	21	20	$611,933	4	9	2	1	$36,050	$0	0	3
KERSHAW	38.46	2.60	$12,078	20	17	$518,837	1	1	0	0	$0	$0	0	0
HAMPTON	38.46	2.60	$11,420	20	13	$565,176	2	0	0	0	$0	$0	0	0
PICKENS	44.23	2.26	$11,339	23	22	$293,693	2	5	1	1	$10,300	$0	0	0
LANCASTER	32.69	3.06	$11,086	17	13	$436,917	0	1	0	0	$0	$0	0	0
GREENWOOD	48.08	2.08	$10,348	25	24	$462,673	2	2	1	1	$103,000	$0	0	0
BARNWELL	36.54	2.74	$10,070	19	19	$384,673	4	4	1	1	$80,000	$0	0	0
NEWBERRY	36.54	2.74	$9,676	19	15	$363,876	0	2	0	0	$0	$0	0	0
MARLBORO	34.62	2.89	$9,632	18	18	$365,728	1	1	0	0	$0	$0	0	0
CHESTERFIELD	26.92	3.71	$8,372	14	14	$182,106	1	1	1	1	$0	$0	1	1
MCCORMICK	19.23	5.20	$7,883	10	10	$334,467	0	0	1	1	$210,204	$0	0	0
DILLON	30.77	3.25	$7,502	16	16	$247,643	2	0	0	0	$0	$0	0	0
DARLINGTON	30.77	3.25	$7,236	16	15	$242,351	3	2	0	0	$0	$0	0	0
LEE	26.92	3.71	$6,517	14	14	$241,889	0	1	0	0	$0	$0	0	0
CALHOUN	25.00	4.00	$6,323	13	13	$190,132	0	1	0	0	$0	$0	0	0
DORCHESTER	53.85	1.86	$6,229	28	23	$223,852	0	4	3	2	$7,830	$0	0	0
CHESTER	23.08	4.33	$5,704	12	12	$153,911	0	2	0	0	$0	$0	0	0
SALUDA	40.38	2.48	$5,602	21	11	$194,373	0	1	0	0	$0	$0	0	0
FAIRFIELD	21.15	4.73	$5,416	11	11	$142,564	2	4	0	0	$0	$0	0	0
WILLIAMSBURG	32.69	3.06	$4,064	17	13	$130,624	1	1	1	1	$25,750	$0	0	0
EDGEFIELD	17.31	5.78	$3,304	9	9	$96,369	0	0	0	0	$0	$0	0	0
JASPER	17.31	5.78	$1,119	9	9	$27,314	0	0	0	0	$0	$0	0	0
Grand Total	**1,903.85**	**126.95**	**$1,268,454**	**990**	**908**	**$59,501,292**	**94**	**301**	**51**	**37**	**$3,220,580**	**$0**	**1**	**17**

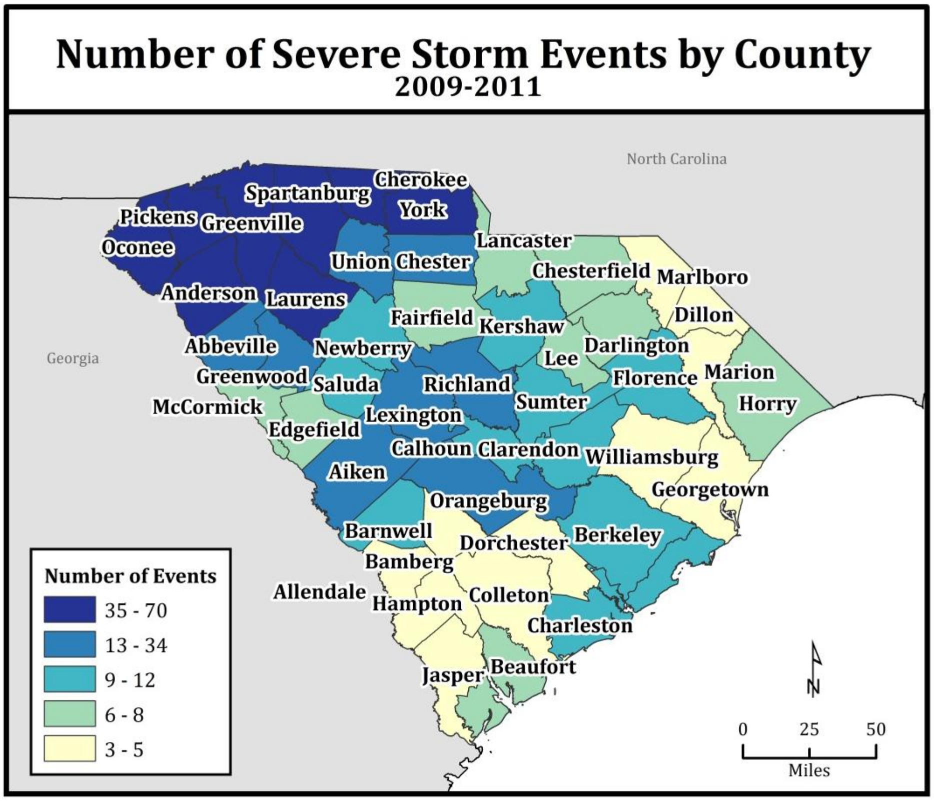


FIGURE 4.D.1—TOTAL SEVERE STORM HAZARD EVENTS

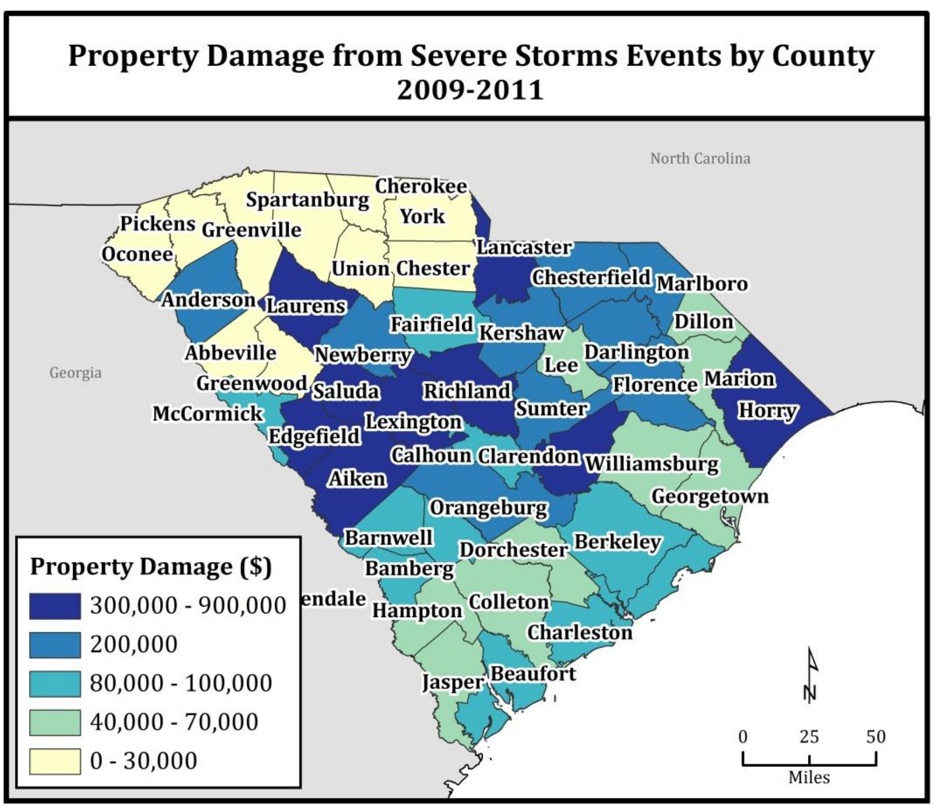


FIGURE 4.D.2—TOTAL SEVERE HAZARD LOSSES

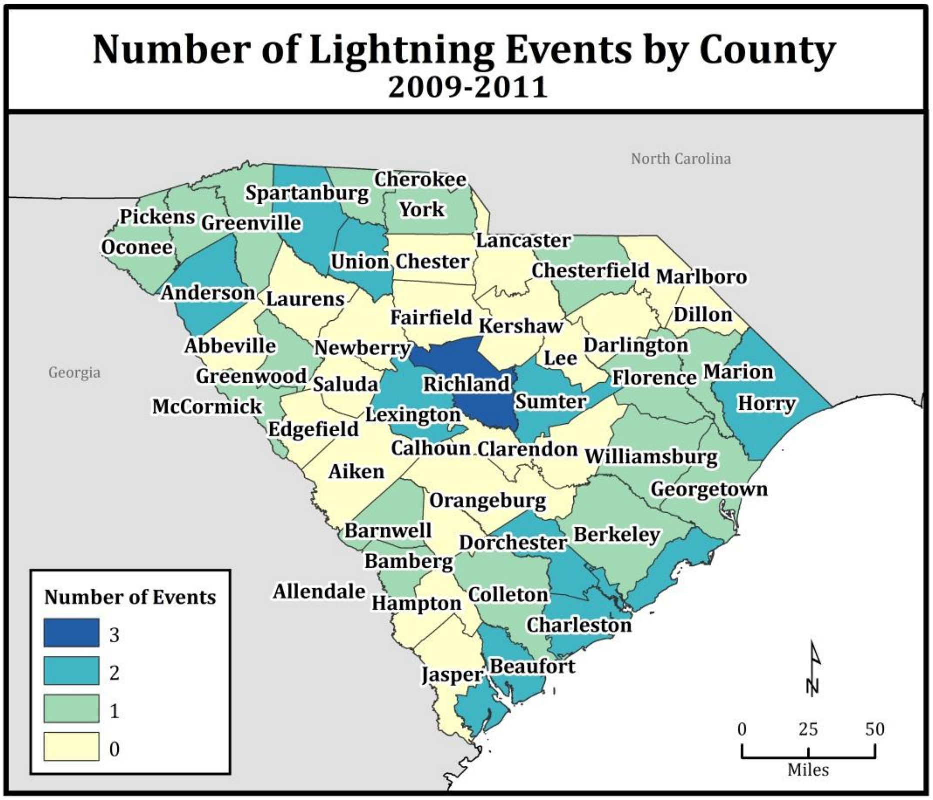


FIGURE4. D.3—TOTAL LIGHTNING HAZARD EVENTS

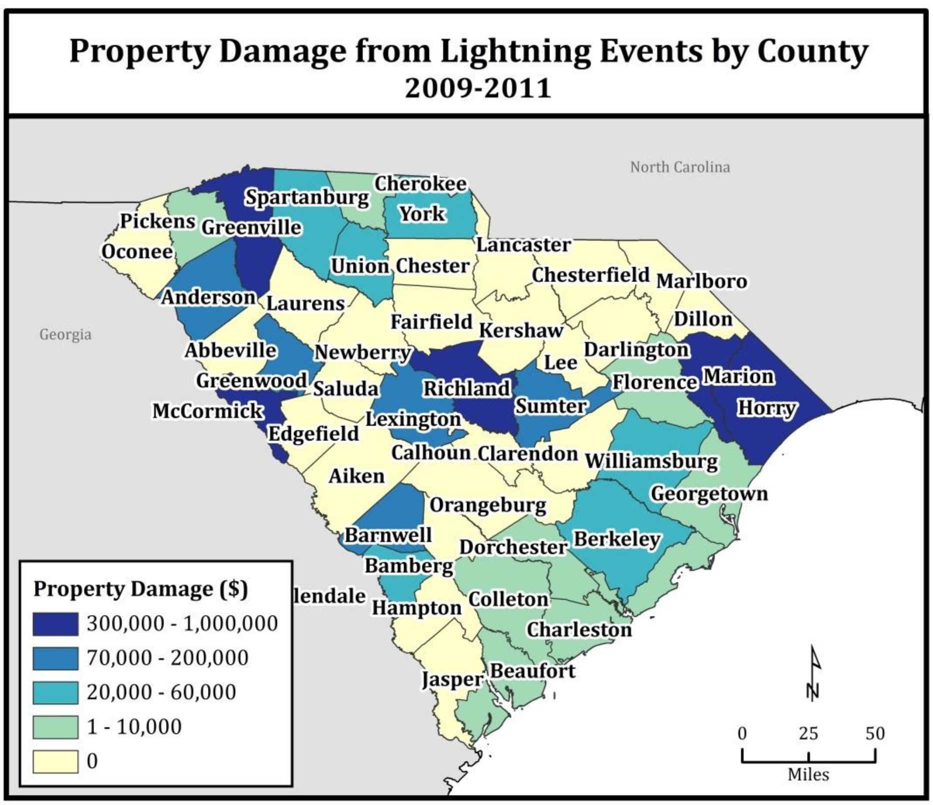


FIGURE 4.D.4—TOTAL LIGHTNING LOSSES

E. TORNADOES

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. They come in all shapes and sizes, and although tornadoes occur worldwide, the United States has the greatest number of tornado events[43]. On average there are over 800 tornadoes reported nationwide, resulting in an average of 80 deaths and 1,500 injuries. Tornadoes may form at any time of the year, but in the United States, the peak of events occurs in the spring and early summer months of March through June, especially during the late afternoon and early evening.

Formation

Tornadoes are most often generated by thunderstorm activity or any situation of severe weather, (sometimes spawned from hurricanes and other coastal storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The presence of vertical wind shear (large change in wind speed and/or direction over a short distance) at the surface and higher up at 5,000 feet in the same location[44] causes a horizontal rotation of the air. Rising and rotating air from the cloud lifts this horizontal "tube" of rotating air so that it becomes vertical. This narrow column of air stretches downwards, rotates, and is fed by the warm, moist air. Once this column extends to the ground, it becomes a tornado. Swirling dust and debris from the surface makes the tornado visible.

Classification

Damage from tornadoes is from extreme winds and flying debris. It is rare to be able to measure pressure changes and wind speeds of a passing tornado, but it is possible to classify its damage. Typically, tornadoes cause the greatest damages to structures of light construction such as residential homes (particularly mobile homes), and their impacts tend to remain localized. The Enhanced Fujita Scale for Tornadoes was developed to measure tornado strength and associated damages (**Table 4.E.1**). The most severe tornado expected in South Carolina is an EF4, although as rare as an EF5 is, it is not impossible.

TABLE 4.E.1—ENHANCED FUJITA SCALE FOR TORNADOES

F-SCALE NUMBER	WIND SPEED (mph)	TYPE OF DAMAGE DONE
EF0	65 - 85	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees push over.
EF1	86 – 110	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111 – 135	Considerable damage. Roofs torn off well-constructed houses; foundations of frame houses shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136 – 165	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166 – 200	Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	>200	Extreme damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation.

Source: NOAA

Location

Tornadoes occur worldwide and can occur in all parts of the United States. Because the location of tornado strikes are not limited to specific geographic regions of the state, all buildings and facilities considered in this plan are considered to be equally exposed. Although tornadoes are more likely to strike in the spring, between the months of March and June, tornadoes can happen year round in the state. In South Carolina, the prevailing winds usually come from the south west, so tornado paths generally follow this direction through the state.

Historical and Notable Events

April 30, 1924: "The Horrell Hill Tornado" ripped a 135-mile path across the state. The longest tornado path recorded in the state's history, it began in Aiken County and ended in Darlington County. Sixty-seven people lost their lives, with almost half the deaths occurring in Richland County and the community of Horrell Hill. According to damage records and historical reports, current estimations rate this storm an F4 on the Fujita Scale, with wind speeds somewhere between 207 mph and 260 mph.

March 28, 1984: An intense low-pressure center moved across the state, spawning 11 tornadoes and numerous severe thunderstorms. The first tornado to appear struck Anderson County, and was quickly followed by a series of 10 tornadoes. The tornadoes traveled across Anderson and Newberry Counties, moving east-northeast through Marlboro County before entering North Carolina. Fifteen people lost their lives, with an additional six deaths indirectly associated with the events. Damages were estimated at over $100 million.

October 11, 2002: A strong EF2 tornado touched down in Georgetown County and destroyed five manufactured homes, a car, and two houses before continuing along a northeastern path for a mile through a residential area of Georgetown. Twenty-eight structures were damaged, including homes, businesses, and churches. Eight people were hospitalized for minor injuries and property damage was estimated at over $750,000.

September 4, 2004: An EF2 tornado caused three injuries and $1.7 million in property damage in Sumter County. Emergency managers reported major damage to 55 homes, with an additional nine homes that were completely destroyed.

Recent Activity (2009 – 2011)

April 10, 2009: Supercell thunderstorms spawned tornadoes in the upstate in the evening. Large hail and straight-line wind damage also occurred. The largest tornado tracked through Aiken County where there was widespread damage, one indirect fatality and around a dozen injuries. Total damage is estimated to be at $6 million dollars.

April 25, 2010: In Darlington County, a thunderstorm developed supercell characteristics and spawned a tornado that touched down multiple times near Oats and Darlington. Damage surveys confirmed an EF2 touched down, with winds up to 115 mph. Residential homes sustained significant damage, while some businesses around Highway 52 sustained moderate damage. Three direct injuries were attributed to this event. Loss estimates place damages at a total of over $7 million dollars.

November 16, 2011: A supercell thunderstorm in the eastern part of the Upstate produced an EF2 tornado in Chester County that moved into York County. Dozens of homes were damaged and many trees were downed. There were 3 direct fatalities and 5 direct injuries. This was the strongest tornado to hit York County in nearly 40 years. Damage from this event was estimated to be at over $2 million dollars.

Vulnerability

The following section provides information on hazard vulnerability across South Carolina by county. Specifically, this section provides tables and maps to summarize historical and recent tornado events (**Figure E.2**) and their associated losses (**Figure E.2**) (property damage, crop damage, fatalities, and injuries). The totals for these losses were calculated using NCDC and SHELDUS data.

Historically, Orangeburg has the highest number of tornado events and the highest number of tornado loss-causing events, although the last three years have been mild. In recent years, Darlington has had the greatest losses from tornados. Details on historical events and losses for other counties are provided in **Table E.2**

TABLE E.2—HISTORICAL AND RECENT TORNADO EVENTS AND LOSSES

County	HISTORICAL EVENTS (1960-2011)								RECENT EVENTS (2009-2011)					
	Future Probability (% chance per year)	Frequency Interval	Annualized Losses	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Deaths	Injuries	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Recorded Crop Damage	Deaths	Injuries
MARLBORO	19.23	5.20	$432,897	10	8	$22,489,106	9	218	0	0	$0	$0	0	0
HORRY	44.23	2.26	$395,946	23	21	$19,990,710	0	107	1	1	$13,663	$0	0	0
CHESTERFIELD	30.77	3.25	$355,800	16	10	$12,061,440	0	40	0	0	$0	$0	0	0
LAURENS	28.85	3.47	$348,306	15	13	$16,731,255	0	55	3	2	$72,520	$0	0	0
RICHLAND	55.77	1.79	$325,035	29	14	$16,890,972	1	17	0	0	$0	$0	0	0
LEXINGTON	40.38	2.48	$224,955	21	11	$11,652,425	1	52	1	1	$1,030,000	$10,300	0	1
BERKELEY	44.23	2.26	$219,414	23	11	$11,409,431	2	25	2	1	$157,653	$0	0	0
ANDERSON	40.38	2.48	$214,045	21	14	$10,951,320	0	9	3	2	$418,306	$0	0	0
NEWBERRY	48.08	2.08	$202,725	25	13	$9,106,067	4	39	2	1	$120,000	$0	0	0
DARLINGTON	34.62	2.89	$202,531	18	16	$10,494,952	1	27	3	1	$7,235,750	$0	0	3
OCONEE	36.54	2.74	$183,917	19	12	$5,684,704	0	23	4	1	$5,150	$0	0	0
GREENWOOD	15.38	6.50	$159,692	8	8	$7,891,848	4	31	2	1	$525,510	$0	0	0
AIKEN	59.62	1.68	$144,407	31	11	$7,381,628	0	21	2	2	$5,275,102	$0	0	14
PICKENS	36.54	2.74	$143,603	19	14	$7,466,061	0	24	1	1	$1,545,000	$0	0	0
DILLON	21.15	4.73	$126,255	11	9	$6,061,890	3	42	1	1	$180,000	$0	0	3
KERSHAW	40.38	2.48	$115,262	21	12	$4,026,622	0	23	0	0	$0	$0	0	0
CHARLESTON	51.92	1.93	$112,802	27	15	$5,865,373	0	14	0	0	$0	$0	0	0
ALLENDALE	23.08	4.33	$102,325	12	6	$5,293,811	1	6	2	1	$2,102,041	$0	0	0
EDGEFIELD	28.85	3.47	$102,262	15	9	$4,034,337	1	18	2	1	$257,500	$30,900	0	0
ABBEVILLE	25.00	4.00	$102,118	13	10	$5,117,609	6	24	2	2	$1,113,871	$0	0	2
BARNWELL	26.92	3.71	$98,703	14	8	$5,026,533	0	21	2	0	$0	$0	0	0
FAIRFIELD	36.54	2.74	$90,119	19	9	$2,615,223	3	24	2	2	$9,354	$14,420	0	0
SPARTANBURG	32.69	3.06	$82,344	17	13	$3,639,013	2	80	0	0	$0	$0	0	0
GREENVILLE	28.85	3.47	$77,000	15	12	$3,916,876	0	24	2	0	$0	$0	0	0
ORANGEBURG	63.46	1.58	$69,255	33	24	$3,510,577	0	17	1	1	$6,180	$0	0	0
FLORENCE	42.31	2.36	$67,855	22	20	$3,522,694	0	26	0	0	$0	$0	0	0
SUMTER	38.46	2.60	$64,602	20	15	$3,352,648	0	8	4	2	$152,520	$0	0	0
MARION	13.46	7.43	$61,050	7	6	$2,588,992	0	11	0	0	$0	$0	0	0
GEORGETOWN	23.08	4.33	$58,204	12	10	$3,026,384	6	10	4	1	$228,000	$0	0	0
LANCASTER	13.46	7.43	$56,922	7	5	$2,778,992	0	3	2	1	$75,190	$0	0	0
DORCHESTER	25.00	4.00	$53,186	13	6	$2,732,879	0	3	0	0	$0	$0	0	0
BEAUFORT	42.31	2.36	$49,268	22	10	$2,561,841	1	13	1	1	$41,200	$0	0	0
CHEROKEE	19.23	5.20	$46,345	10	10	$1,872,364	0	36	0	0	$0	$0	0	0
CHESTER	21.15	4.73	$41,559	11	7	$2,160,841	1	4	1	0	$0	$0	0	0
CALHOUN	21.15	4.73	$37,545	11	7	$1,695,625	1	6	1	1	$250,000	$12,000	0	0
WILLIAMSBURG	19.23	5.20	$35,704	10	9	$1,695,781	0	18	0	0	$0	$0	0	0
CLARENDON	46.15	2.17	$33,993	24	15	$1,756,494	1	27	3	1	$26,000	$0	0	0
SALUDA	15.38	6.50	$24,533	8	3	$672,182	0	3	0	0	$0	$0	0	0
YORK	32.69	3.06	$20,512	17	12	$1,027,240	0	8	3	1	$1,000,000	$0	3	5
UNION	21.15	4.73	$18,384	11	6	$936,526	0	2	2	1	$420,408	$0	0	0
MCCORMICK	28.85	3.47	$12,352	15	7	$433,100	0	6	1	1	$0	$3,090	0	0
COLLETON	26.92	3.71	$7,890	14	8	$410,182	0	10	0	0	$0	$0	0	0
HAMPTON	25.00	4.00	$7,350	13	6	$382,012	0	6	0	0	$0	$0	0	0
BAMBERG	30.77	3.25	$5,501	16	5	$283,150	0	2	0	0	$0	$0	0	0
LEE	19.23	5.20	$2,076	10	6	$105,028	0	8	1	1	$12,360	$0	0	0
JASPER	17.31	5.78	$2,072	9	5	$107,655	0	1	0	0	$0	$0	0	0
Grand Total	**1,455.77**	**169.52**	**$5,338,626**	**757**	**481**	**$253,412,393**	**47**	**1,189**	**61**	**33**	**$22,273,280**	**$70,710**	**3**	**28**

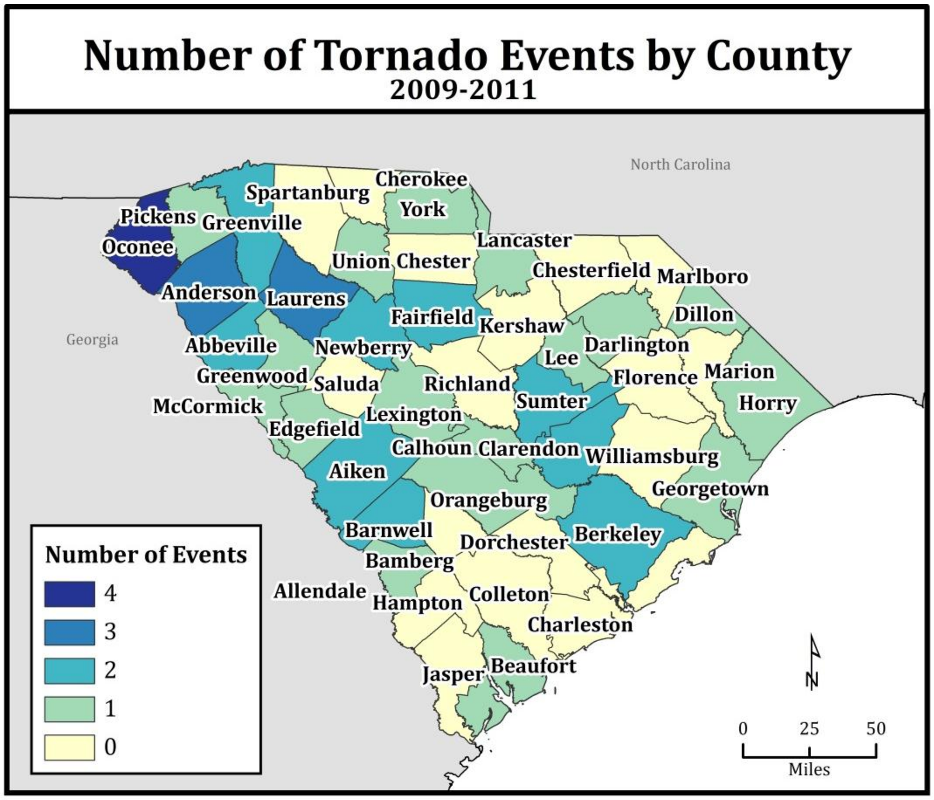


FIGURE 4.E.1—TOTAL TORNADO HAZARD EVENTS

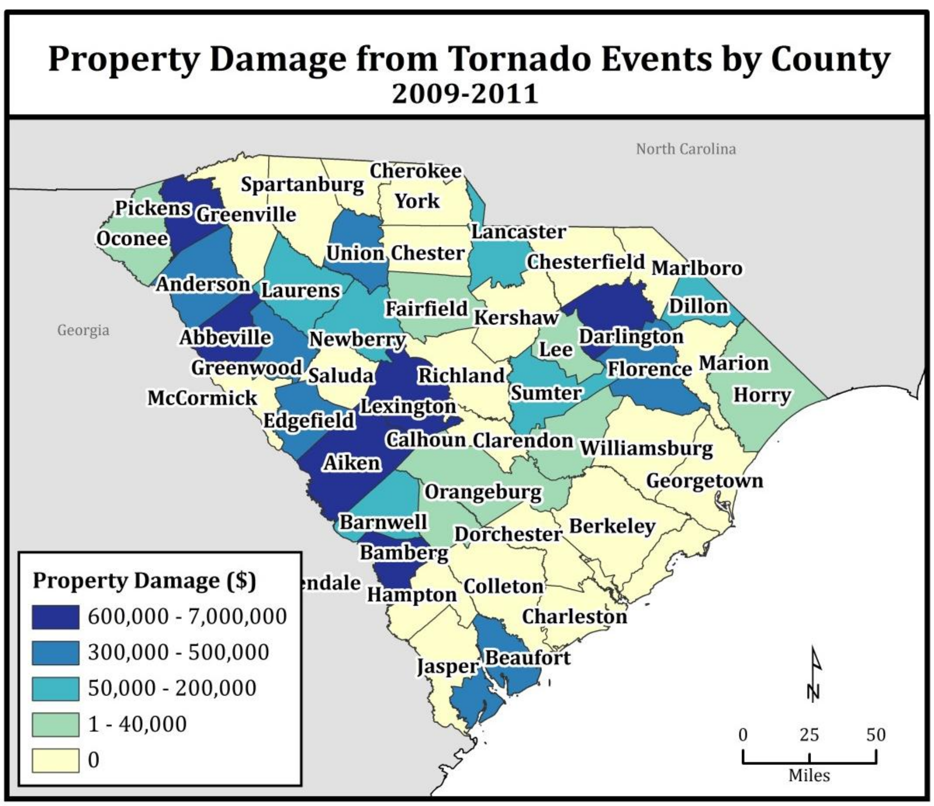


FIGURE 4.E.2—TOTAL TORNADO LOSSES

F. FLOODING

Flooding is the most frequent and costly natural hazard in the United States, causing almost 4,000 deaths since 1950. About 75% of presidential disaster declarations are related to flooding[45]. The National Weather Service monitors conditions that lead to flooding 24 hours a day, 7 days a week, and is in charge of issuing forecasts, watches, and warnings. Most fatalities are due to people driving into flooded areas.

Formation

Floods are a potential threat for all parts of the country at any time of the year. Floods are generally the result of excessive precipitation over a span of days, intense rain in a short period of time, river overflow from an ice or debris jam, failure of water structures (dams, levees), or when excessive snow melt and rain occur in combination. The National Weather Service monitors conditions that may lead to floods. A tool used by forecast centers called the National Weather Service River Forecast System (NWSRFS) assists in forecasting flash floods by assessing soil moisture condition (soil type and moisture content) to develop flash flood guidance. When precipitation amounts exceed flash flood guidance, flooding can be expected[46].

Classification

The terms used to classify floods are diverse, as are the number of subtypes. Floods may be broadly classified into two categories, as either general floods or flash floods (**Table 4.F.1**).

General floods

These floods are usually long-term events that may last for several days; riverine and coastal flooding fall under general flood types.

Flash floods

Floods are caused by locally heavy rains in areas where water runs off quickly, moving at very high speeds. "Walls" of water can reach heights of 10 to 20 feet from this sudden movement. Flash floods can cause severe damage; it is able to pick up great debris, uproot trees, roll boulders, destroy buildings, and damage bridges and roads. Urban flooding, dam/levee failure, and debris or ice jam water fall under flash flooding type. Flash floods are the killer floods, often catching people unaware in their vehicles when bridges and roads are washed out. In fact, 70% of flash flood deaths occur when vehicles are driven into the water.

South Carolina has five major river basins and one coastal region. The State's rivers generally start in the northwest and flow southeasterly to the Atlantic Ocean, passing through three physiographic areas:

1. The Blue Ridge Mountains in the far northwestern corner of the State
2. The Piedmont Plateau
3. The Coastal Plain

There are five distinctive types of flooding in South Carolina. Flash, riverine, and coastal are related to the three physiographic areas listed above.

1. **Flash flooding**: rapid onset events which occur from short, heavy rainfall, accumulating in areas faster than the ground is able to absorb it. Urban flooding: occurs because of impervious surfaces (streets, roads, parking lots, residential and business areas that inhibits ground water absorption, causing runoff
2. **Riverine flooding**: this occurs when an increase in water volume within a river channel causes an overflow onto the surrounding floodplain. This type of flooding is the most common in the United States and is may also be termed 'overbank flooding'[47].
3. **Coastal flooding**: water pushed inland as a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, nor'easters, and other coastal storms.
4. **Local drainage problems**: can occur anywhere in the State where the ground is flat, where the drainage pattern has been disrupted, or where channels or culverts have not been maintained.
5. **Dam/levee failure**: each dam in the State has the potential to fail and suddenly release its impounded water, flooding the land downstream. The threat from dam failure increases from aging dams, and when additional dams are built for retention basins and amenity ponds in new developments. Many dams exist on smaller streams that are not mapped as floodplains or subject to floodplain regulation, leaving downstream residents unaware of potential risks.

TABLE 4.F.1—FLOOD CLASSIFICATIONS

General Flood	Flash Flood
Riverine	Urban
Coastal	Dam/levee failure
Local drainage	Debris/ice jam

Location

Although flooding can happen anywhere in South Carolina, given the atmospheric conditions and/or lack of proper maintenance to flood control and drainage systems, flooding typically occurs in floodplains. Floodplains are flat areas adjacent to streams and rivers that are prone to flooding. This area absorbs any overflow of water from the stream or river banks. Floodplains are designated by the frequency of the flood that is large enough to cover the area. For example, the 10-year floodplain will be covered by the 10-year flood and the 100-year floodplain by the 100-year flood. Flood frequencies such as the 100-year flood are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. Another way of expressing the flood frequency is the chance of occurrence in a given year, which is the percentage of the probability of flooding each year. For example, a 10 year flood has a 10 percent probability of occurring in any given year, a 50 year event has a 2% probability, a 100 year event a 1% probability, and a 500 year event a 0.2% probability. While unlikely, it is possible to have two 100 or even 500 year floods within months or years of each other.

Historical and Notable Events

June 6, 1903 (Riverine and Flash Flooding): The greatest number of people ever killed by floodwaters in South Carolina occurred on the Pacolet River in Spartanburg County. Floods were reportedly 20 feet above normal stage in some areas. Six textile mills in Pacolet and Clifton were destroyed, 70 homes and businesses were decimated, and reports of 50-80 people lost their lives[48].

September 21–24, 1928 (Riverine and Coastal Flooding): Severe flooding caused by a hurricane was reported statewide, with rainfall totals ranging from 10 to 12 inches. Many bridges were destroyed, and roads and railways were impassable. Property losses reached an estimated $4 to $6 million.

October 3, 1994 (Coastal and Flash Flooding): Record-breaking rainstorms, with unofficially recorded rainfall exceeding 13 inches within 24-hour period in Beaufort County, impacted the South Carolina coast. Heaviest flooding was reported on Hilton Head Island. Floodwaters covered many streets, damaged more than 147 homes, six government buildings, 36 businesses and at least 45 cars. Approximately 37 roads washed out or were damaged. Based on current cost estimations, $1,466,073 in property damages was reported.

October 13, 1994 (Flash and Coastal Flooding): Bands of heavy precipitation produced four to ten inches of rain along the South Carolina coast, causing varying degrees of flash flooding in 40 counties. Flash flooding caused $2,932,000 in property damages and $11,720 in crop damages, based on current dollar estimations. The heaviest rainfall and the worst flooding occurred in Charleston, southern Colleton County, Beaufort County and southern Jasper County. Coastal flooding caused $36,651,824 in property damages and $73,260 in crop damages based on current dollar estimates.

August 24–31, 1995 (Flooding and Flash Flooding): Remnants of Tropical Storm Jerry dumped an initial three to five inches of rain. As additional bands moved across the state, flash flooding developed in various areas and roads became flooded and impassable. At least six bridges were destroyed in Laurens County, several small dams broken, and three fatalities. The current total cost estimates for the damages caused by this extended flood event equal $18,717,472.

August 14–15, 1998 (Flash Flood): A flash flood in Spartanburg County rapidly developed after four to five inches of rainfall, which fell during a very short time period. Property damages of $3,145,092, based on current cost estimates, were reported. For a second consecutive night, on August 15, a flash flood occurred in Spartanburg County causing additional property damages of $629,018.

March 20, 2003 (Flash Flood): Heavy rainfall caused floods that contributed to $1.3 million in property damage in Greenville, and over $1.0 million in Spartanburg. The flooding was significant in Berea, Taylors, and Mauldin. In Berea, some residents had to be rescued via canoe from their homes (NCDC Storm Data Reports Online).

July 29, 2004 (Flash Flood): In Greenville, $3.5 million in property damage was caused by a nearly stationary thunderstorm which produced four to nine inches of rainfall in approximately four hours resulting in major flooding in areas from Berea to downtown Greenville. The Reedy River crested at 19.2 feet in downtown Greenville, the second highest level on record (NCDC Storm Data reports Online, 2006). At least 30 homes were condemned (NCDC Storm Data Reports, 2006).

Recent Activity (2009-2011)

According to FloodSmart.gov, the average annual U.S. flood losses from 2002 to 2011 was more than $2.9 billion. Since 1978, the NFIP has paid $36.9 (updated 2010) billion for flood insurance claims and related costs with over $1.8 billion flood claims filed in 2011[49].

July 22, 2009 (Flash Flood): Torrential downpours caused flash flooding in east central Lexington and west central Richland. Three to five inches of rain fell within one to three hours and water levels was recorded to be nearly twelve feet at the gage on Rocky Branch Creek (Main and Whaley Streets). Several people had to be rescued from their vehicles. Flooding extended to the USC campus and Five Points in Columbia. Property damage was estimated to be at $300,000.

January 25, 2010 (Flash and Urban Flood): Widespread and heavy rain produced between two and four inches of rain across the Upstate. Flash flooding developed because the ground was already saturated. Widespread flooding was observed across eastern York County and severe urban flooding required the rescue of five motorists. Property damage was estimated to be at $120,000.

January 25, 2010 (Flash Flood): Thunderstorms produced 3 inches of rain within a couple of hours in Lancaster County, washing out roads and causing streams to overflow. Property damage was estimated to be at $60,000.

June 27, 2010 (Flood): Heavy rainfall of four to six inches caused flooding in downtown Hemingway in Williamsburg County. Water flooded the parking lot of the Post Office, causing a dumpster to move to a different location in the parking lot. Flood waters also entered the Masonic Temple and the Town Hall. This event caused $50,000 in property damage.

August 18, 2010 (Flash Flood): Heavy rain from severe thunderstorms caused flash flooding in Columbia and other low lying areas around the Midlands. Water level was up to four feet deep in some places and caused flooding in apartments. Several vehicles were caught in the floods, and the Rocky Branch Creek gage crested at 10.7, at a level of 3.5 feet above flood stage. Property damage was estimated to be at $22,000.

July 9, 2011 (Flood): A slow moving frontal boundary produced torrential rainfall in the city of Georgetown, producing five to seven inches of rain. Flooding was reported at City Hall, Duke St, South Congdon, Hazard St, Wood St, and Kaminski St. Two people had to be rescued from their cars. Property was estimated at $20,000.

August 11, 2011 (Flash Flood): Scattered thunderstorms produced two to four inches of rain causing flash flooding in Maxcy Gregg Park, Five Points, and USC. Vehicles were submerged when water levels rose to four to six feet of water. Property damage was estimated to be at $44,000.

August 20, 2011 (Flash Flood, Urban, and Local Drainage): Thunderstorms developed over upstate South Carolina producing urban flooding and small hail. The city of Spartanburg had significant flood conditions that caused road closures and property damage of $50,000.

September 23, 2011 (Flash Flood, Urban, and Local Drainage): A line of thundershowers produced flood conditions in Downtown Columbia when two to four inches of rain fell in less than two hours. Sewers overflowed in the Rosewood Community, and there was flooding in Five Points and along Rocky Branch Creek. Property damage is estimated at $35,000.

September 25, 2011 (Flash Flood): Scattered thunderstorms around Richland County produced heavy rain of one to three inches within an hour. Wind also took down trees and power lines, and there were widespread reports of flooding and road closures through Columbia. Property damage is estimated to be at $104,000.

Vulnerability

The following section provides information on hazard vulnerability across South Carolina by county. Specifically, this section provides tables and maps to summarize historical and recent flood events (**Figure 4.F.1**) and their associated losses (**Figure 4.F.2**) (property damage, crop damage, fatalities, and injuries). The totals for these losses were calculated from the NCDC Storm Events database and SHELDUS.

Historically, Greenville has the highest number of annualized losses, and the highest number of flood loss-causing events. Details on historical events and losses for other counties are provided in **Table 4.F.2**. In addition, flood maps were created for 100- (**Figure 4.F.3**) and 500-year (**Figure 4.F.4**) flood events. Where available, the new DFIRM maps depicting the 1% chance flood were used. Because not all counties have approved DFIRMS at this time, Q3 data was used where available in addition to modeled flood data using Hazus. State buildings are including in these maps to show vulnerability of these buildings based on their location in flood plains. Dam locations (**Figure 4.F.5**) and dam hazard class (**Figure 4.F.6**) are also shown at the county level. Of the dams located in South Carolina, 153 dams are classified as high hazard dams. According to the South Carolina Dam Safety Program, 92% of the high hazard dams in the state have Emergency Action Plans with inundation mapping. The next SHMP update will include more DFIRMS as they become available for use and publication.

Repetitive Loss Properties

Another way to gauge flood hazard risk is to identify and analyze the number of properties that have filed multiple flood insurance claims. Properties that meet this criterion are typically referred to as repetitive loss properties[50]. For planning purposes, information on repetitive loss properties in the state has been researched and information is available for each county. To provide a frame of reference for this study, the Federal Emergency Management Agency's Repetitive Loss Properties Strategy was used. **Table 4.F.3** provides a general summary of these target properties within the state by jurisdiction, including, the number of claims, the dollar amount of cumulative losses paid for claims, the number of repetitive loss properties. **Table 4.F.4** shows the Severe Repetitive Loss data as of March 31, 2013. Local officials maintain specific property information for these repetitive loss properties; however, details are not included in this plan due to privacy restrictions.

Five counties including Beaufort, Charleston, Dorchester, Georgetown and Horry share approximately 93 percent of the total repetitive loss properties. Horry County has the largest number of repetitive loss properties and highest average claim payment. Most of these repetitive loss properties are located on beachfront properties. Residents in these properties are unwilling to leave their properties that pose a significant flood and hurricane risk due to the picturesque location. The statewide average of repetitive loss claims is 2.4. One property in Newberry County suffered seven claims. For severe repetitive loss properties, the City of Charleston had the greatest number with 40 losses and 8 total properties. North Myrtle Beach was the second highest community. In total, the State had 149 severe repetitive losses at 30 properties for a total payout of over $3 million.

TABLE 4.F.2—HISTORICAL AND RECENT FLOOD EVENTS AND LOSSES

County	HISTORICAL EVENTS (1960-2011)								RECENT EVENTS (2009-2011)					
	Future Probability (% chance per year)	Frequency Interval	Annualized Losses	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Deaths	Injuries	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Recorded Crop Damage	Deaths	Injuries
SPARTANBURG	138.46	0.72	$414,761	72	25	$21,143,239	4	4	9	1	$50,000	$0	0	0
GREENVILLE	80.77	1.24	$395,299	42	29	$19,358,714	2	9	10	2	$21,651	$0	0	0
HORRY	73.08	1.37	$280,171	38	26	$14,019,253	1	0	0	0	$0	$0	0	0
PICKENS	75.00	1.33	$257,594	39	24	$6,203,714	5	6	1	0	$0	$0	0	0
BEAUFORT	82.69	1.21	$234,393	43	20	$11,209,272	0	0	2	2	$197,385	$0	0	0
CHARLESTON	205.77	0.49	$195,849	107	29	$9,199,174	1	3	21	3	$186,557	$0	0	0
COLLETON	57.69	1.73	$193,404	30	17	$9,073,237	0	0	1	1	$140,662	$0	0	0
LAURENS	40.38	2.48	$135,284	21	18	$6,620,755	1	0	0	0	$0	$0	0	0
JASPER	36.54	2.74	$124,368	19	15	$5,492,458	0	0	0	0	$0	$0	0	0
OCONEE	44.23	2.26	$108,215	23	19	$5,184,164	1	3	5	1	$10,510	$0	0	0
FLORENCE	65.38	1.53	$87,953	34	20	$3,901,372	0	0	0	0	$0	$0	0	0
CHEROKEE	61.54	1.63	$83,342	32	20	$2,600,053	1	1	1	0	$0	$0	0	0
ABBEVILLE	36.54	2.74	$74,005	19	12	$3,009,688	0	0	0	0	$0	$0	0	0
GEORGETOWN	194.23	0.51	$66,066	101	22	$2,924,454	1	1	5	2	$25,255	$0	0	0
ANDERSON	100.00	1.00	$58,353	52	21	$2,619,055	0	1	4	1	$42,041	$0	0	0
UNION	63.46	1.58	$54,373	33	19	$1,950,878	1	0	0	0	$0	$0	0	0
GREENWOOD	36.54	2.74	$53,610	19	14	$2,393,017	1	0	1	0	$0	$0	0	0
YORK	69.23	1.44	$51,995	36	20	$1,822,267	0	0	4	1	$123,600	$0	0	0
HAMPTON	57.69	1.73	$40,533	30	12	$1,144,029	0	0	0	0	$0	$0	0	0
WILLIAMSBURG	32.69	3.06	$40,469	17	15	$1,149,490	1	0	1	1	$51,500	$0	0	0
LEXINGTON	48.08	2.08	$39,672	25	19	$1,183,916	1	4	1	1	$8,408	$0	0	0
NEWBERRY	59.62	1.68	$39,482	31	14	$1,174,893	2	1	0	0	$0	$0	0	0
ALLENDALE	32.69	3.06	$39,092	17	13	$1,155,207	0	0	0	0	$0	$0	0	0
KERSHAW	42.31	2.36	$38,744	22	19	$1,145,909	4	0	2	2	$22,870	$0	0	0
BERKELEY	117.31	0.85	$38,618	61	21	$1,042,790	1	0	4	1	$1,051	$0	0	0
RICHLAND	46.15	2.17	$37,645	24	22	$1,078,206	0	1	15	3	$597,067	$0	0	0
DORCHESTER	73.08	1.37	$35,665	38	17	$889,383	0	1	6	3	$18,177	$0	0	0
ORANGEBURG	82.69	1.21	$25,991	43	15	$456,024	1	0	2	1	$8,408	$16,816	0	0
AIKEN	36.54	2.74	$24,020	19	16	$371,475	1	0	1	1	$14,420	$0	0	0
BARNWELL	32.69	3.06	$23,399	17	13	$334,835	0	0	1	1	$4,204	$4,204	0	0
CHESTER	51.92	1.93	$23,078	27	18	$325,560	0	1	0	0	$0	$0	0	0
SUMTER	38.46	2.60	$22,625	20	17	$308,903	0	0	1	1	$22,000	$0	0	0
LANCASTER	76.92	1.30	$22,589	40	19	$298,316	0	0	2	2	$76,514	$8,408	0	0
DARLINGTON	34.62	2.89	$22,133	18	16	$651,160	0	0	0	0	$0	$0	0	0
BAMBERG	32.69	3.06	$21,786	17	13	$251,093	0	0	1	1	$4,204	$4,204	0	0
LEE	50.00	2.00	$21,174	26	14	$233,192	0	0	0	0	$0	$0	0	0
CALHOUN	30.77	3.25	$21,127	16	13	$231,365	0	0	0	0	$0	$0	0	0
CLARENDON	36.54	2.74	$20,894	19	15	$219,300	1	0	1	1	$2,102	$0	0	0
FAIRFIELD	46.15	2.17	$19,740	24	17	$158,608	0	0	1	1	$10,510	$0	0	0
SALUDA	21.15	4.73	$18,954	11	10	$118,412	0	0	0	0	$0	$0	0	0
DILLON	28.85	3.47	$17,979	15	13	$253,169	0	0	0	0	$0	$0	0	0
MARION	36.54	2.74	$15,827	19	16	$311,421	1	0	1	1	$1,030	$0	0	0
MARLBORO	34.62	2.89	$15,365	18	16	$370,619	1	0	2	1	$35,000	$0	0	0
EDGEFIELD	23.08	4.33	$13,607	12	11	$302,538	0	0	0	0	$0	$0	0	0
CHESTERFIELD	51.92	1.93	$11,702	27	18	$182,408	0	0	2	2	$12,570	$0	0	0
MCCORMICK	25.00	4.00	$9,751	13	10	$112,453	0	0	0	0	$0	$0	0	0
Grand Total	**2,742.31**	**100.10**	**$3,590,694**	**1,426**	**802**	**$144,179,439**	**32**	**36**	**108**	**38**	**$1,687,697**	**$33,633**	**0**	**0**

TABLE 4.F.3—REPETITIVE LOSS INFORMATION

Community Name	Building Payments	Contents Payments	Total Payments	Losses	Properties
Anderson County *	$62,251.43	$4,974.56	$67,225.99	3	1
Bamberg, City Of	$20,691.00	$4,090.02	$24,781.02	2	1
Beaufort County*	$750,746.76	$17,401.36	$768,148.12	31	10
Hilton Head Island, Town Of	$671,084.90	$131,945.75	$803,030.65	70	30
Port Royal, Town Of	$3,873.93	$0.00	$3,873.93	2	1
Charleston, City Of	$6,709,713.18	$1,606,172.75	$8,315,885.93	489	170
Hanahan, City Of	$75,874.43	$9,970.03	$85,844.46	20	7
North Charleston, City Of	$733,709.35	$659,349.57	$1,393,058.92	58	20
Charleston County*	$344,092.74	$54,831.42	$398,924.16	50	18
Folly Beach, City Of	$1,152,170.93	$205,483.53	$1,357,654.46	94	33
Isle Of Palms, City Of	$1,560,739.02	$308,447.36	$1,869,186.38	76	33
James Island, Town Of	$685,099.45	$96,583.75	$781,683.20	55	23
McClellanville, Town Of	$86,879.78	$23,469.58	$110,349.36	6	3
Mount Pleasant, Town Of	$735,143.31	$60,738.78	$795,882.09	82	29
Seabrook Island, Town Of	$42,869.96	$0.00	$42,869.96	3	1
Sullivans Island, Town Of	$749,030.62	$132,393.28	$881,423.90	52	21
Cherokee County*	$27,152.25	$0.00	$27,152.25	2	1
Cheraw, Town Of	$38,583.00	$13,703.20	$52,286.20	2	1
Edisto Beach,Town Of	$190,105.69	$10,575.54	$200,681.23	34	10
Darlington County *	$101,727.15	$22,353.44	$124,080.59	11	5
Darlington, City Of	$64,281.59	$3,007.87	$67,289.46	6	3
Dorchester County *	$127,308.20	$7,449.83	$134,758.03	9	4
Edgefield County *	$5,352.84	$0.00	$5,352.84	2	1
Fairfield County *	$18,596.25	$8,083.00	$26,679.25	4	1
Florence County *	$173,383.79	$25,842.69	$199,226.48	14	6
Georgetown County *	$5,771,334.96	$1,317,146.86	$7,088,481.82	284	128
Georgetown, City Of	$254,487.63	$186,403.48	$440,891.11	29	10
Pawleys Island, Town Of	$4,077,859.41	$608,084.17	$4,685,943.58	146	65
Waccamaw Neck Flood District	$189,832.67	$60,000.00	$249,832.67	2	1
Greenville County *	$637,017.41	$113,973.46	$750,990.87	47	22
Greenville, City Of	$118,498.33	$111,481.15	$229,979.48	21	5
Mauldin, City Of	$417,778.46	$75,526.91	$493,305.37	27	8
Conway, City Of	$862,616.80	$115,869.67	$978,486.47	46	17
Horry County *	$10,525,897.70	$2,190,856.68	$12,716,754.38	391	150
Loris, City Of	$110,111.98	$0.00	$110,111.98	3	1
Myrtle Beach, City Of	$1,005,130.28	$347,890.47	$1,353,020.75	45	19
North Myrtle Beach, City Of	$7,258,888.56	$1,305,785.64	$8,564,674.20	461	194
Hardeeville, Town Of	$19,804.72	$9,319.69	$29,124.41	4	2
Jasper County*	$83,087.94	$3,180.85	$86,268.79	10	5

Lancaster County *	$87,717.18	$15,281.75	$102,998.93	3	1
Columbia, City Of	$298,105.80	$126,295.32	$424,401.12	36	11
Irmo, Town Of	$15,715.45	$0.00	$15,715.45	2	1
Lexington County *	$160,895.02	$29,714.00	$190,609.02	19	7
Marion County*	$41,279.59	$1,439.52	$42,719.11	11	5
Mullins, City Of	$19,489.52	$0.00	$19,489.52	4	1
Newberry County*	$4,834.06	$0.00	$4,834.06	2	1
Newberry, City Of	$53,234.49	$29,132.58	$82,367.07	11	2
Oconee County *	$34,786.40	$9,100.00	$43,886.40	2	1
Orangeburg, City Of	$3,115.58	$0.00	$3,115.58	2	1
Easley, City Of	$104,264.36	$521.73	$104,786.09	4	2
Forest Acres, City Of	$20,035.62	$0.00	$20,035.62	3	1
Richland County*	$155,936.38	$81,367.41	$237,303.79	5	1
Spartanburg County *	$31,589.48	$15,052.62	$46,642.10	8	4
Spartanburg, City Of	$72,178.96	$4,255.50	$76,434.46	8	2
Rock Hill, City Of	$40,470.90	$30,000.00	$70,470.90	2	1
TOTAL	**$47,606,457.19**	**$10,194,546.77**	**$57,801,003.96**	**2,815**	**1,102**

TABLE 4.F.4—SEVERE REPETITIVE LOSS INFORMATION

Community Name	Building Payments	Contents Payments	Total Payments	Losses	Properties
Beaufort County*	$37,084.20	$1,360.20	$38,444.40	6	1
Charleston, City of	$941,664.36	$188,709.55	$1,130,373.91	40	8
North Charleston, City Of	$83,379.74	$25,695.07	$109,074.81	4	1
Isle Of Palms, City Of	$394,654.26	$7,972.05	$402,626.31	10	3
Mount Pleasant, Town Of	$86,344.91	$0.00	$86,344.91	8	1
Edisto Beach,Town Of	$44,125.13	$5,984.19	$50,109.32	9	1
Georgetown County *	$176,991.71	$40,243.90	$217,235.61	12	2
Pawleys Island, Town Of	$91,377.28	$17,835.82	$109,213.10	4	1
Greenville County *	$46,732.50	$1,357.62	$48,090.12	2	1
Mauldin, City Of	$64,635.48	$27,073.53	$91,709.01	5	1
Horry County *	$299,233.99	$97,459.22	$396,693.21	13	3
North Myrtle Beach, City Of	$313,347.07	$151,176.75	$464,523.82	23	5
Newberry, City Of	$41,989.22	$28,272.20	$70,261.42	8	1
Spartanburg, City Of	$62,877.91	$4,255.50	$67,133.41	5	1
TOTAL	**$2,684,437.76**	**$597,395.60**	**$3,281,833.36**	**149**	**30**

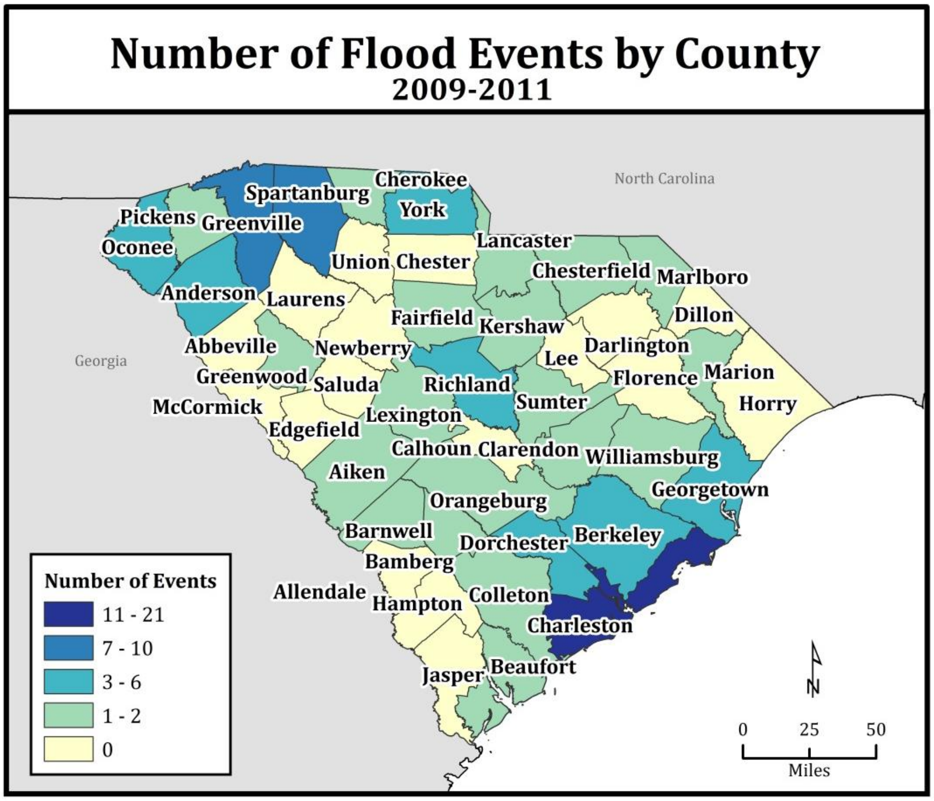


FIGURE 4.F.1—TOTAL FLOOD EVENTS

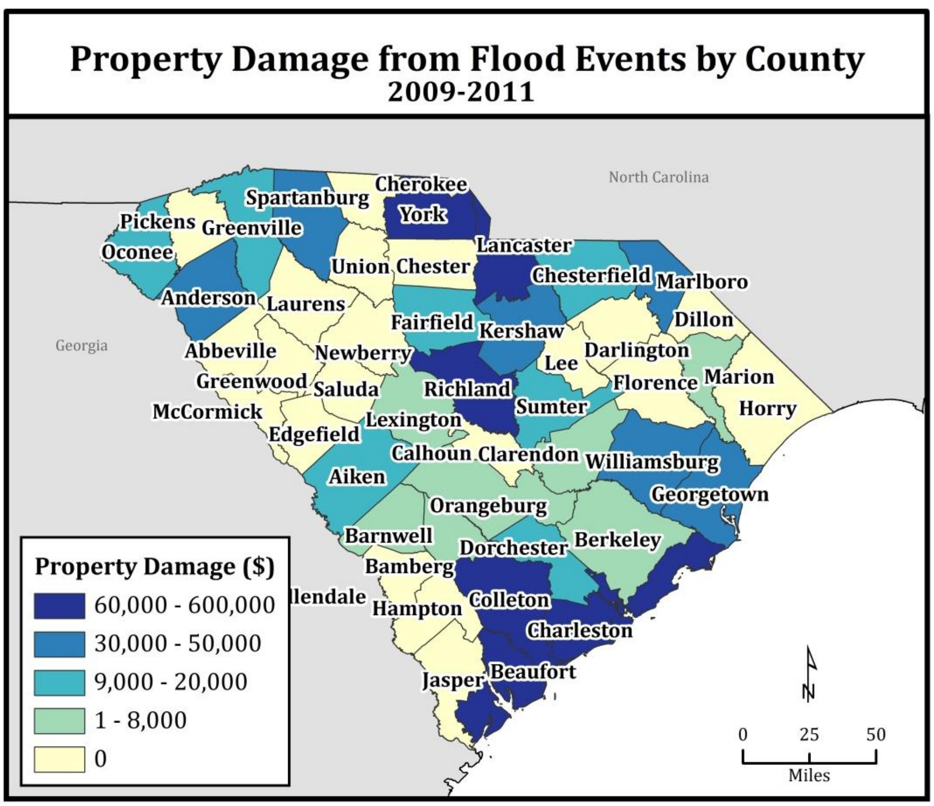


FIGURE 4.F.2—TOTAL FLOOD LOSSES

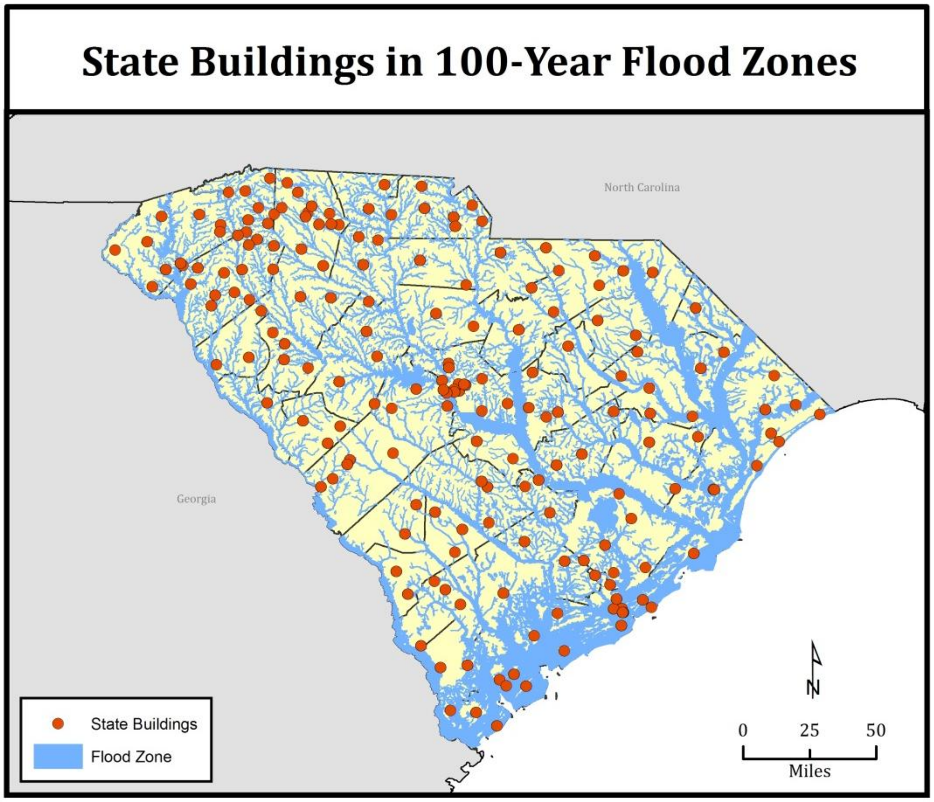


FIGURE 4.F.3—100-YEAR FLOOD ZONES

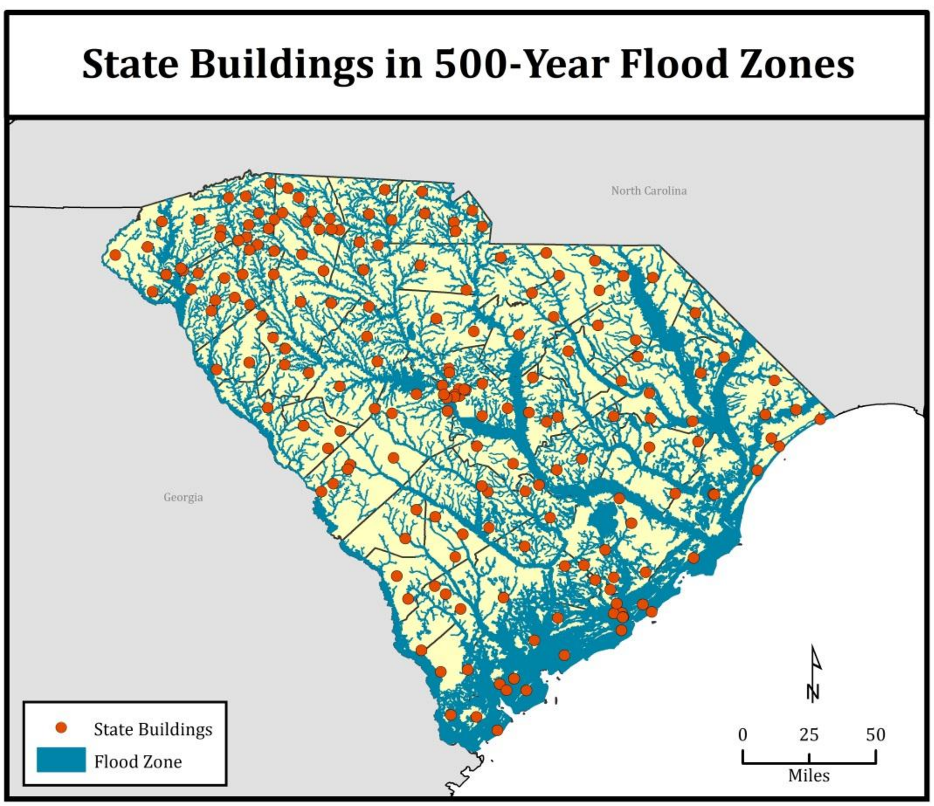


FIGURE 4.F.4—500-YEAR FLOOD ZONES (with 100-Year included)

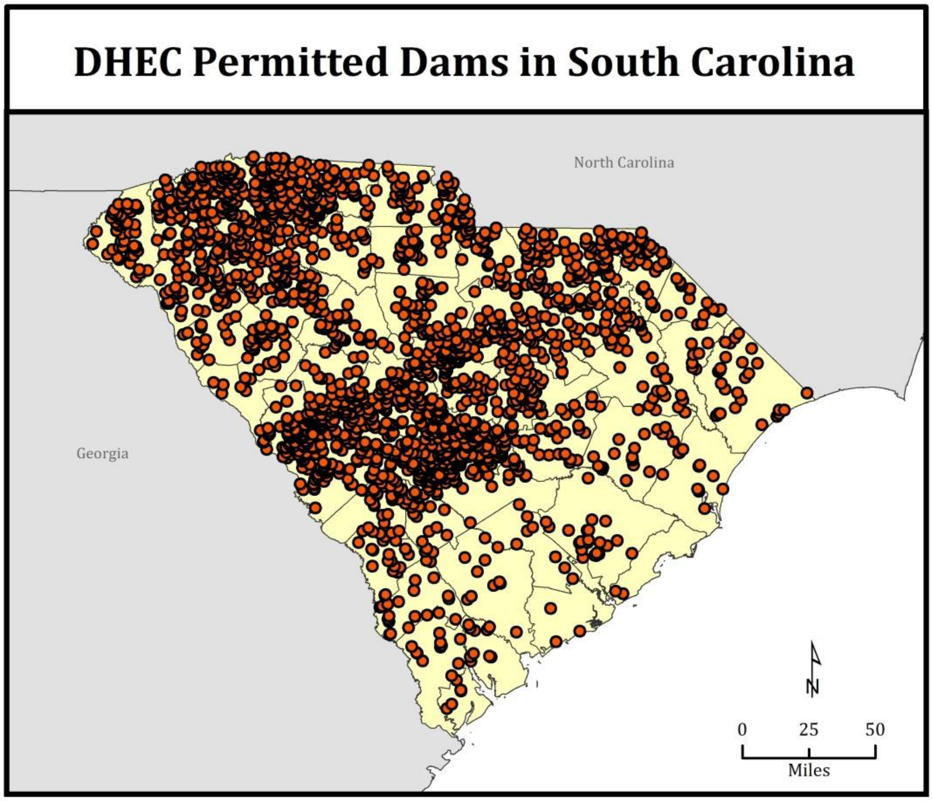


FIGURE 4.F.5—DAM LOCATIONS

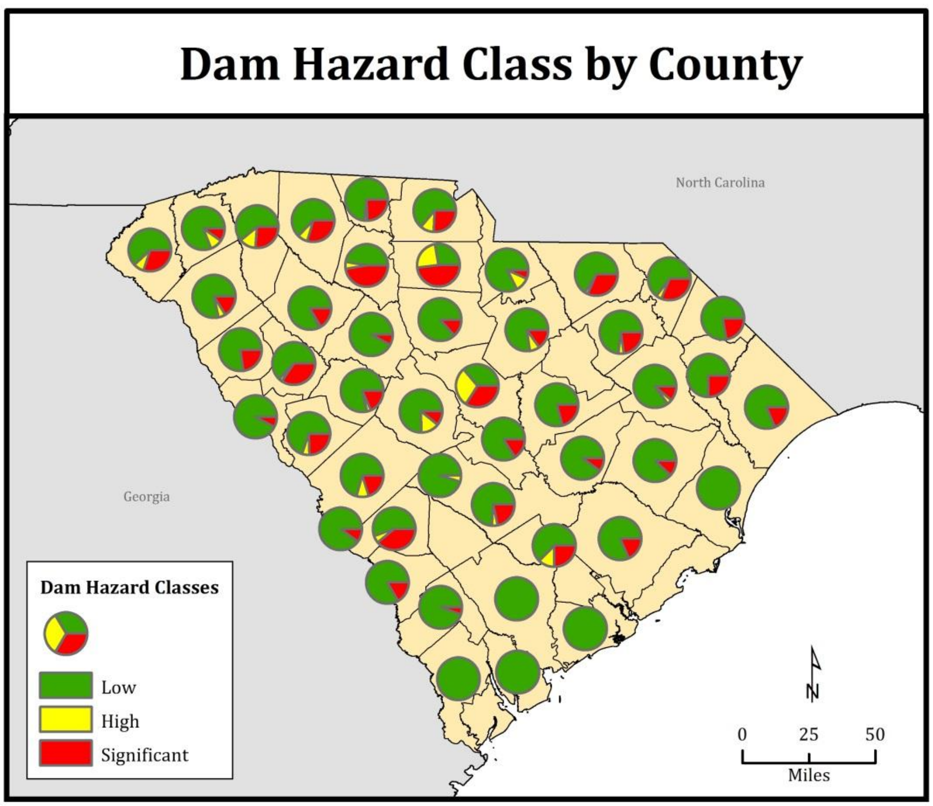


FIGURE 4.F.6—DAM HAZARD CLASSIFICATION

G. WILDFIRE

Wildfire is often thought of as a bad thing, but it is a natural process for the environment to clear dead vegetation[51]. According to the South Carolina Forestry Commission, any type of forest, grass, brush, or outdoor fire that is not controlled or managed is a wildfire[52]. NOAA's National Weather Service provides daily fire weather forecasts and warnings in coordination with local, state, and federal fire agencies[53]. Every year, fire weather forecasters issue over 8,000 Red Flag Warnings and Fire Weather Watches for the country, indicating that there is an increasing wildfire danger[54]. In South Carolina, the average number of fires per year is 3,000 and yearly average acreage burned is 18,000. Accounting for the size and population of the state, this is one of the highest rates in the United States. Fire danger season is highest in late winter and early spring. For South Carolina, the highest danger of fire is during the winter because of dead or dormant vegetation that can act as forest fuel.

Formation

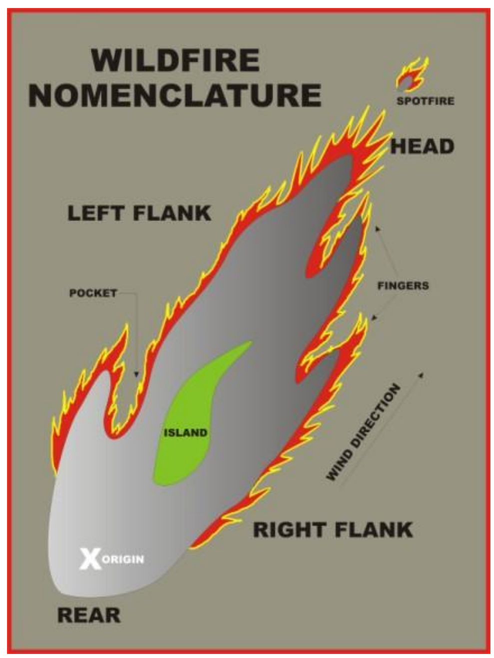
Any material that can burn is fire fuel. In forests, these include dead leaves, grasses, branches and logs, and pine needles. Over 80 percent of forest fires are started by negligent human behavior (campfires, smoking, debris burning, arson, fireworks). The second most common cause of wildfires is lightning, but only 2% of wildfires in South Carolina are attributed to lightning. Weather is an important factor in dealing with wildfire. Wind and relative humidity affects fire spread and flammability. The most dangerous part of the fire is the head. Firefighters typically attack this part of the fire first since this is the most damaging.

Classification

There are three classes of wild fires: surface fire, ground fire, and crown fire. A surface fire is the most common of these three classes moving slowly burns along a forest floor. A ground fire (muck fire) is usually started by lightning or human carelessness and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees.

Location

The majority of wildfires are human-caused or from lightning strikes, therefore they can occur anywhere in the state of South Carolina. For the purpose of this plan, all buildings and facilities are considered to be equally exposed.



Source: http://www.state.sc.us/forest/refwild.htm

Historical and Notable Events[55]

April 1966, the Gaston Fire: In what became the worst week in South Carolina wildfire history, this event (March 30-April 5) had firefighters battling hundreds of fires, with ten major fires between 1,500-8,000 acres. The Gaston fire was already one of the many but by Friday, within an hour of early afternoon, almost one thousand acres of forest burned. This particular fire burned for a day and a half, burning a total of 7,400 acres. The heat intensity of this fire is estimated to be eleven times that of a normal wildfire and was said to have spawned thunderstorms.

April 1976, the Clear Pond Fire: The largest forest fire in South Carolina, this burned 30,000 acres in Horry County and was caused by an unattended campfire. Low relative humidity and winds pushed the fire to burn 11,000 acres by midnight on April 10th, when it first started. The fire was not contained until April 17th. Surprisingly, no homes were lost, and no fatalities or injuries occurred from this fire.

March 1985, the Red Fox Road Fire: This fire started on the morning of March 12th, when a tree branch "ripped into a power line along Kershaw County's Highway 97". High winds, estimated as high as 40 miles per hour caused this fire to burn out of control. Over two thousand acres were burned and eight homes destroyed.

Recent Activity (2009-2011)

April 22-28, 2009: A wildfire, known as the Highway 31 Fire started near the city of Conway in Horry County. The fire spread east and northeast during dry and windy conditions. A state of emergency was declared for Horry County on the 23rd. A total of 19,600 acres were burned, 2,500 people evacuated, and 76 homes destroyed, with another 100 damaged. The fire was contained on the 28th. The estimated total damage from this fire was at 40 million dollars, with 25 million of that total attributed to structural damage and 15 million to woodland loss. South Carolina received a Fire Management Assistance Grant for this fire.

March 22, 2011: Warm temperatures and low moisture created set the conditions for a wildfire in Jasper County. The SC Forestry Commission reported a 125 acre fire, which damaged a home and a shed. Property damage estimates were given at $50,000.

March 24-25, 2011: Warmer temperatures and low relative humidity persisted and a 1247 acre fire burned in Dorchester County. Sixty to 70 homes were ordered evacuated, and the property damage estimates were at $500,000.

Vulnerability

The following section provides information on hazard vulnerability across South Carolina by county. Specifically, this section provides tables and maps to summarize historical and recent wildfire events (**Figure 4.G.1**) and their associated losses (**Figure 4.G.2**) (property damage, crop damage, fatalities, and injuries). The totals for these losses were calculated from the National Climatic Data Center (NCDC) Storm Events database, and the Spatial Hazard Events and Losses Database for the US (SHELDUS). The large quantity of points is best represented as a raster point density map for display in **Figures 4.G.1** and **4.G.4**. **Figure G.2** displays at the county level, the total acreage burned from wildfire events from 2009 through 2011.

Historically, Horry County has the highest number of annualized losses, and Dorchester County has the highest number of wildfire loss-causing events. Details on historical events and losses for other counties are provided in **Table 4.G.1**

A wildfire surface map was also created to show the probability of one or more acres burning for South Carolina (**Figure 4.G.3**).

The data used for the analysis here come from a variety of sources. Historical loss and damage information comes from SHELDUS, while the number of events and acreage burned comes from the South Carolina Forestry Commission. The probability of acreage burned is analysis performed by the Hazards and Vulnerability Research Institute.

TABLE 4.G.1—HISTORICAL AND RECENT WILDFIRE EVENTS AND LOSSES

County	HISTORICAL EVENTS (1988-2011)								RECENT EVENTS (2009-2011)					
	Future Probability (% chance per year)	Frequency Interval	Annualized Losses	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Deaths	Injuries	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Recorded Crop Damage	Deaths	Injuries
GEORGETOWN	11,233	0.01	$410,951	2,696	3	$21,118,123	0	0	3	1	$21,020,408	$0	0	0
HORRY	15,300	0.01	$410,951	3,672	3	$21,118,123	0	0	1	1	$21,020,408	$0	0	0
CHARLESTON	8,913	0.01	$39,679	2,139	3	$1,812,000	1	2	1	1	$1,714,286	$0	0	0
BEAUFORT	7,104	0.01	$25,943	1,705	3	$1,097,714	0	0	1	1	$1,000,000	$0	0	0
KERSHAW	10,179	0.01	$17,181	2,443	3	$102,970	0	0	0	0	$0	$0	0	0
DORCHESTER	10,696	0.01	$16,823	2,567	4	$623,464	0	0	2	2	$525,750	$0	0	0
BERKELEY	26,208	0.00	$12,207	6,290	3	$383,429	0	0	2	1	$285,714	$0	0	0
JASPER	15,083	0.01	$7,674	3,620	3	$147,714	0	0	2	1	$50,000	$0	0	0
CHESTER	4,054	0.02	$6,974	973	3	$97,714	0	0	0	0	$0	$0	0	0
CHESTERFIELD	12,267	0.01	$6,974	2,944	3	$97,714	0	0	0	0	$0	$0	0	0
FAIRFIELD	6,321	0.02	$6,974	1,517	3	$97,714	0	0	0	0	$0	$0	0	0
LANCASTER	4,321	0.02	$6,974	1,037	3	$97,714	0	0	0	0	$0	$0	0	0
UNION	3,492	0.03	$6,974	838	3	$97,714	0	0	0	0	$0	$0	0	0
YORK	3,758	0.03	$6,974	902	3	$97,714	0	0	0	0	$0	$0	0	0
ABBEVILLE	5,588	0.02	$6,712	1,341	2	$97,714	0	0	0	0	$0	$0	0	0
AIKEN	16,467	0.01	$6,712	3,952	2	$97,714	0	0	0	0	$0	$0	0	0
ALLENDALE	2,425	0.04	$6,712	582	2	$97,714	0	0	0	0	$0	$0	0	0
ANDERSON	4,563	0.02	$6,712	1,095	2	$97,714	0	0	0	0	$0	$0	0	0
BAMBERG	4,308	0.02	$6,712	1,034	2	$97,714	0	0	0	0	$0	$0	0	0
BARNWELL	4,521	0.02	$6,712	1,085	2	$97,714	0	0	0	0	$0	$0	0	0
CALHOUN	4,546	0.02	$6,712	1,091	2	$97,714	0	0	0	0	$0	$0	0	0
CHEROKEE	5,029	0.02	$6,712	1,207	2	$97,714	0	0	0	0	$0	$0	0	0
CLARENDON	16,521	0.01	$6,712	3,965	2	$97,714	0	0	0	0	$0	$0	0	0
COLLETON	19,258	0.01	$6,712	4,622	2	$97,714	0	0	1	0	$0	$0	0	0
DARLINGTON	11,483	0.01	$6,712	2,756	2	$97,714	0	0	0	0	$0	$0	0	0
DILLON	6,450	0.02	$6,712	1,548	2	$97,714	0	0	0	0	$0	$0	0	0
EDGEFIELD	3,196	0.03	$6,712	767	2	$97,714	0	0	0	0	$0	$0	0	0
FLORENCE	19,204	0.01	$6,712	4,609	2	$97,714	0	0	0	0	$0	$0	0	0
GREENVILLE	4,913	0.02	$6,712	1,179	2	$97,714	0	0	0	0	$0	$0	0	0
GREENWOOD	6,179	0.02	$6,712	1,483	2	$97,714	0	0	0	0	$0	$0	0	0
HAMPTON	8,113	0.01	$6,712	1,947	2	$97,714	0	0	0	0	$0	$0	0	0
LAURENS	4,779	0.02	$6,712	1,147	2	$97,714	0	0	0	0	$0	$0	0	0
LEE	7,658	0.01	$6,712	1,838	2	$97,714	0	0	0	0	$0	$0	0	0
LEXINGTON	19,654	0.01	$6,712	4,717	2	$97,714	0	0	0	0	$0	$0	0	0
MARION	4,021	0.02	$6,712	965	2	$97,714	0	0	0	0	$0	$0	0	0
MARLBORO	7,288	0.01	$6,712	1,749	2	$97,714	0	0	0	0	$0	$0	0	0
MCCORMICK	3,129	0.03	$6,712	751	2	$97,714	0	0	0	0	$0	$0	0	0
NEWBERRY	3,717	0.03	$6,712	892	2	$97,714	0	0	0	0	$0	$0	0	0
OCONEE	4,025	0.02	$6,712	966	2	$97,714	0	0	0	0	$0	$0	0	0
ORANGEBURG	21,633	0.00	$6,712	5,192	2	$97,714	0	0	0	0	$0	$0	0	0
PICKENS	5,196	0.02	$6,712	1,247	2	$97,714	0	0	0	0	$0	$0	0	0
RICHLAND	8,363	0.01	$6,712	2,007	2	$97,714	0	0	0	0	$0	$0	0	0
SALUDA	3,329	0.03	$6,712	799	2	$97,714	0	0	0	0	$0	$0	0	0
SPARTANBURG	5,225	0.02	$6,712	1,254	2	$97,714	0	0	0	0	$0	$0	0	0
SUMTER	12,371	0.01	$6,712	2,969	2	$97,714	0	0	0	0	$0	$0	0	0
WILLIAMSBURG	28,942	0.00	$6,712	6,946	2	$97,714	0	0	0	0	$0	$0	0	0
Grand Total	**421,020.83**	**0.75**	**$1,198,054**	**101,045**	**107**	**$50,116,688**	**1**	**2**	**13**	**8**	**$45,616,566**	**$0**	**0**	**0**

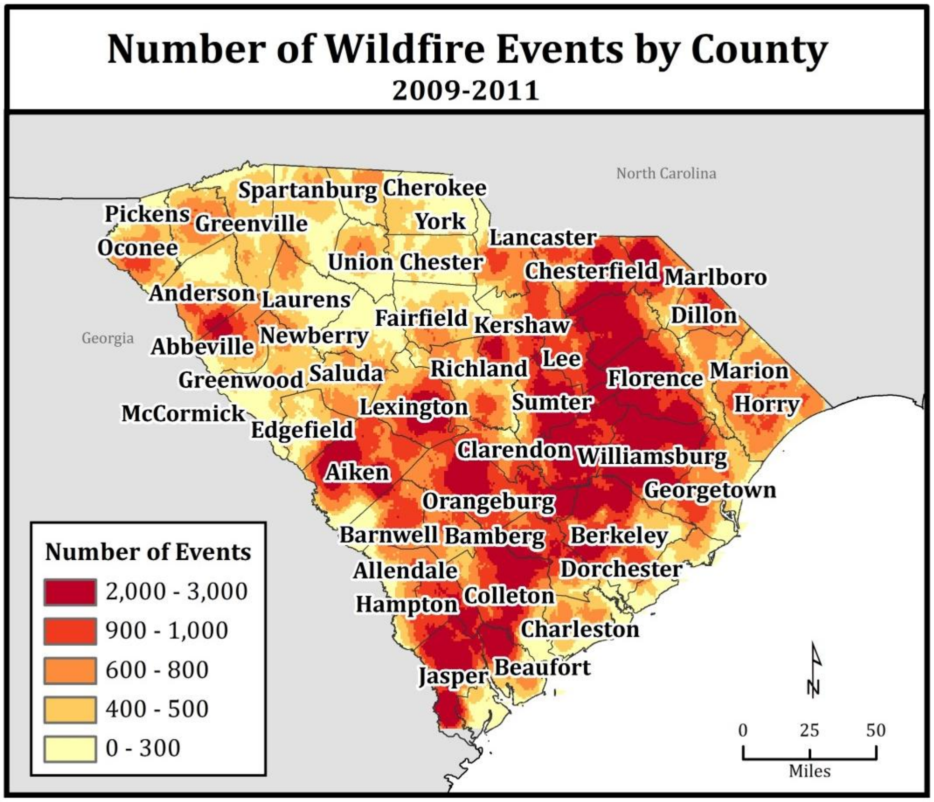


FIGURE 4.G.1—TOTAL WILDFIRE EVENTS

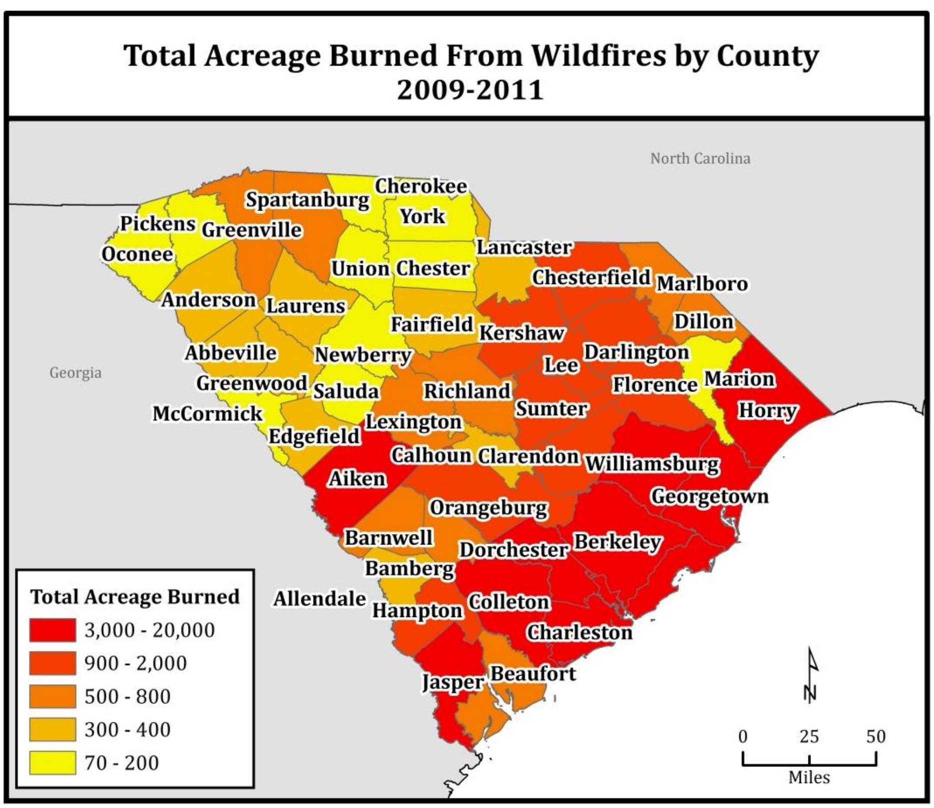


FIGURE 4.G.2—TOTAL ACREAGE BURNED

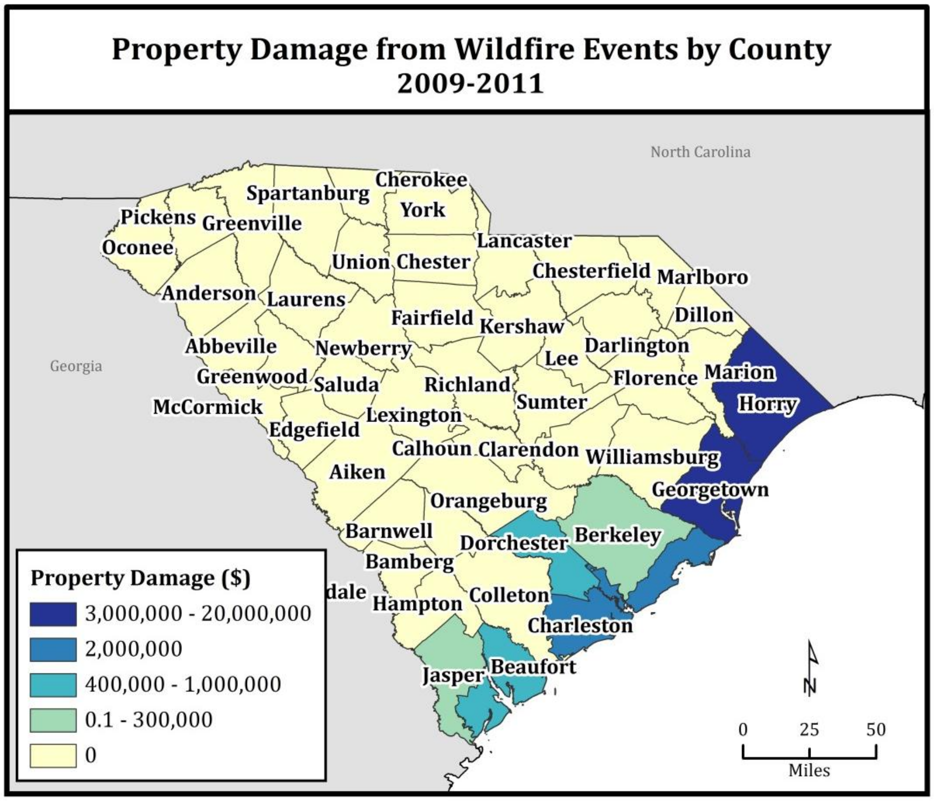


FIGURE 4.G.3—TOTAL WILDFIRE LOSSES

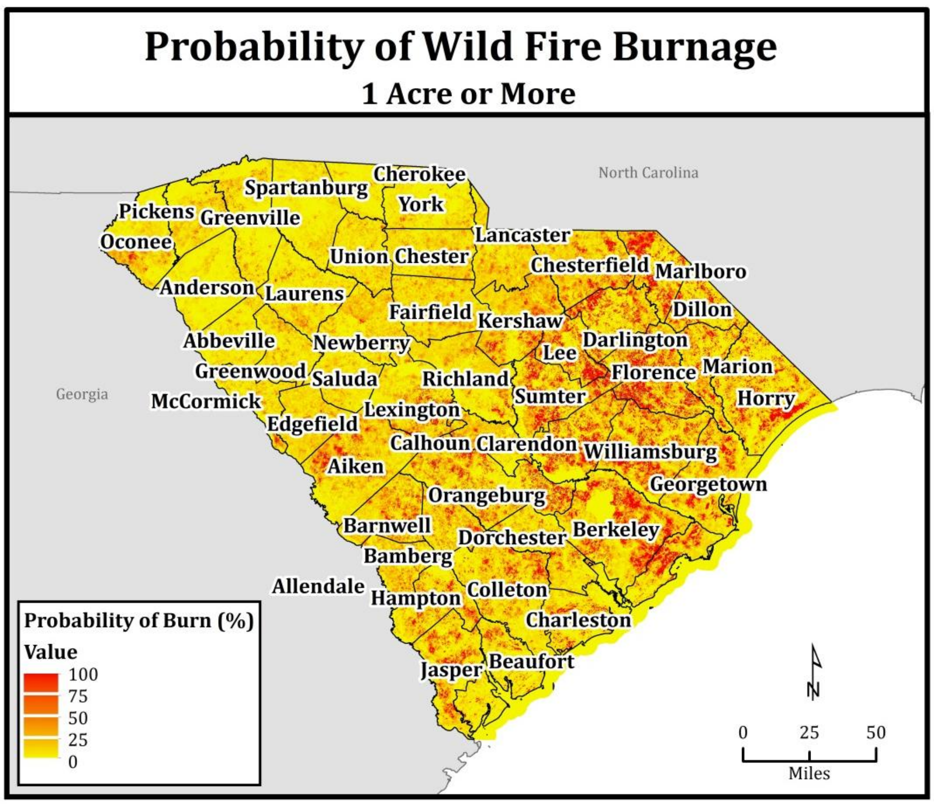


FIGURE 4.G.4—PROBABILITY OF 1 OR MORE ACRES BURNED

H. DROUGHT

Periodic droughts are documented throughout South Carolina's historical climate record. Drought can be measured by departures of precipitation from a long-term average over an extended time, using drought indices such as the Palmer Drought Severity Index, or by specific impacts. The Palmer Drought Severity Index (PDSI) is one of the most widely used drought indicators with data extending back to 1895. According to the historical PDSI record, moderate to severe drought has occurred 19% of the time in South Carolina since 1895. **Table H.1** provides a frequency of drought occurrence by climate division based on the PDSI.

Lake Hartwell, December 2010, NWS Columbia

TABLE H.1—FREQUENCY OF DROUGHT IN EACH CLIMATE DIVISION BASED ON THE PDSI (1895-2012)

Climate Division	Drought Severity				Total
	Incipient	Moderate	Severe	Extreme	
Mountain	17%	12%	4%	1%	34%
Northwest	16%	14%	5%	3%	38%
North Central	20%	12%	5%	2%	39%
Northeast	19%	9%	4%	3%	35%
West Central	18%	13%	5%	2%	38%
Central	20%	11%	5%	3%	39%
Southern	21%	13%	4%	3%	40%

The time series of monthly PDSI values averaged for the entire state is shown in **Figure 4.H.1**. An index of -4 or less represents extreme drought, -3 to -3.9, severe drought, -2.0 to -2.9, moderate drought, and -1.0 to -1.9, incipient drought. Values between -1 and +1 are considered normal. Larger positive values indicate anomalously wet conditions. Based on the PDSI, the longest period of drought occurred in the 1950s when 75 consecutive months were in some level of drought (February 1951 to April 1957). The second longest drought episode based on the PDSI occurred over the last few years with 33 consecutive months in drought (April 2010 – December 2012). Details on SC's most notable droughts are provided below.

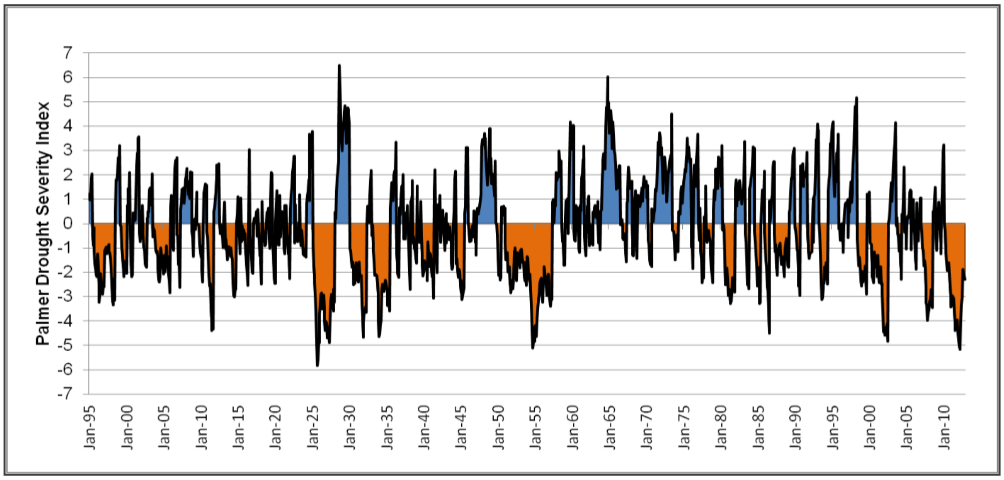


FIGURE 4.H.1—MONTHLY STATEWIDE PALMER DROUGHT SEVERITY INDEX FOR SC, (1995 – 2010)

Classification

Drought has a natural and human component; therefore it is defined in both conceptual and operational terms. Droughts are generally classified as meteorological, agricultural, hydrological, or socioeconomic[56].

Meteorological drought is based on the degree of dryness for a given period.

Agricultural drought is based on the impact to agricultural activity from a deficit in precipitation, soil moisture, ground water supply, or reservoir levels.

Hydrological drought is from a precipitation deficit that affects the surface and subsurface water supply (stream flow, lake levels, ground water).

Socioeconomic drought reflects the adverse supply and demand relationship between economic goods that are dependent on precipitation and water supply.

In the United States, the US Drought Monitor is a weekly map product produced through the partnership of the National Drought Mitigation Center, US Department of Agriculture (USDA), and the National Oceanic and Atmospheric Administration (NOAA). Drought Monitor maps measure present drought levels and future outlooks through a synthesis of multiple drought indices[57]. Meteorologists predict and monitor droughts using drought indices, as well as monitoring variables that reflect precipitation patters, stream flow, and soil moisture[58] .

Location

Drought occurs in a broad geographic area and can occur anywhere in the state of South Carolina. For the purpose of this plan, all buildings and facilities are considered to be equally exposed.

Historical and Notable Events

February through November 1925: During the drought of 1925 the state experienced rainfall deficits reaching 18.23 inches. The growing season alone had a recorded 12.41-inch rain deficit. Livestock water was scarce, deep wells went dry and hydroelectric power was non-existent.

January through December 1954: Total statewide precipitation for that year was a mere 32.96 inches, which set the current record for driest year ever recorded in the state. An excessively hot summer only exacerbated its impact. According to National Weather Service reports, the crop yield was only 10 percent of its 10-year average production rate.

May through August 1993: Several locations in South Carolina broke records during the 1993 drought. For example, in July of 1993, Greenville-Spartanburg Airport recorded the hottest and driest month on record. Only 0.75" of rain was recorded during July 1993 making it the driest July on record since 0.80'" in July 1977. Similar records were set at locations around the state. The drought and record heat cost the State a total of $22,518 million crop losses, including $63.9 million for corn, $55.1 million for vegetables and fruits, $47.2 million for tobacco, $31.7 million for cotton and $27.8 million for soybeans. The drought, which started at the height of the crop growing season in May and June, devastated South Carolina pastures and hay production. The total loss for livestock, hay and pasture was estimated at $34.7 million.

1998–2002 and Fall 2006 – Spring 2009: The drought resulted in adverse impacts to agriculture, forestry, tourism, power generation, public water supply, and fisheries. The drought significantly reduced streamflows across the state. The hydrologic drought impacted water supplies, irrigation capacity and many lake-related businesses as well as golf courses. The drought significantly contributed to the southern pine beetle epidemic. Trees weakened by drought are more susceptible to the tree-killing beetles, which also significantly increased wildfire vulnerability. Agricultural impacts ranged from limited water for livestock, reduced feed crops, and lowered crop quality. In 1998 and 2002, a natural disaster was declared for most of South Carolina's 46 counties by the United States Department of Agriculture.

Dry Creek, York County, 2008

Recent Activity (2009 – 2011)

The Drought Response Committee (DRC) is the state's major drought decision-making body, represented by statewide and local committee members. The SC Drought Response Act and the supporting regulations established drought indicators that are taken into account by the DRC. The DRC evaluates drought conditions and characteristics of each drought alert phase: incipient, moderate, severe and extreme. The DRC declares the drought status for each county in four drought management areas of the state (**Figure H.2**).

During 1998-2012, SC faced several multi-year droughts; summer 1998-fall 2002, fall 2006-spring 2009, and is currently coping with an ongoing drought that has lasted uninterrupted since July 2010. **Figure 4.H.3** displays the percent area of the State in drought based on the SC Drought Response Committee drought declarations. Three of the driest years on record occurred during the 2001-2012 period based on statewide precipitation totals (**Table 4.H.2**).

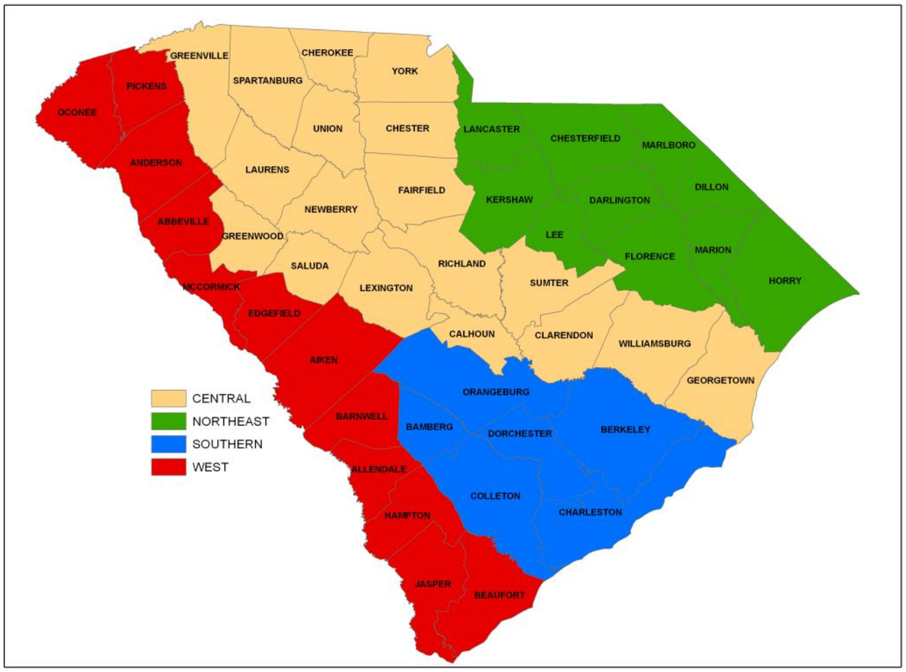


FIGURE 4.H.2—SC DROUGHT MANAGEMENT AREAS

During these recent multi-year drought periods, groundwater, lake levels, and streamflow were at or below record lows in most areas. Major lakes in the State have been seriously impacted, owing to reduced inflow. In 2008, Lake Hartwell dropped to 19 feet below its normal water level. The lake reached its lowest level, 637.49 ft.-msl, on record during December 2008. Lake Marion dropped 9 feet during 2007 reaching the lowest elevation (66.27 ft-msl – December 27, 2007), since the 1950s drought. Smaller farm ponds, especially ones not fed by springs dried up because of lowered water tables and heavy irrigation, both of which resulted from lack of precipitation[59].

Drought –impacted wetlands adjacent to Lake Marion, 2007

The ongoing drought also reduced the amount of water stored in shallow and deep aquifers. The S.C. Department of Natural Resources maintains a network of groundwater wells used to monitor groundwater levels in the major aquifer systems of the State. A total of 115 wells are currently being monitored. Typical periods of record are 12-18 years, but range from 1 to over 50 years. Of these 115 wells, 40 wells have experienced record low levels since 2007. Most of these lows occurred during the late summer and early fall of 2007 and 2008[60]. **Figure 4.H.3** provides a hydrograph of groundwater levels in upper Greenville County during the multiple-drought periods since 1998.

Although the risk assessment data in this plan covers 2009 – 2011, it is of note that in April 2013, South Carolina's DRC declared that the state was officially out of the drought. No counties are considered in a drought at the time of this plan's publication. The U.S. Seasonal Drought Outlook for April 18 – July 31, 2013 declared a "major improvement" in South Carolina's drought condition that would carry forward into the coming months. For more information, see **Figure 4.H.4**.

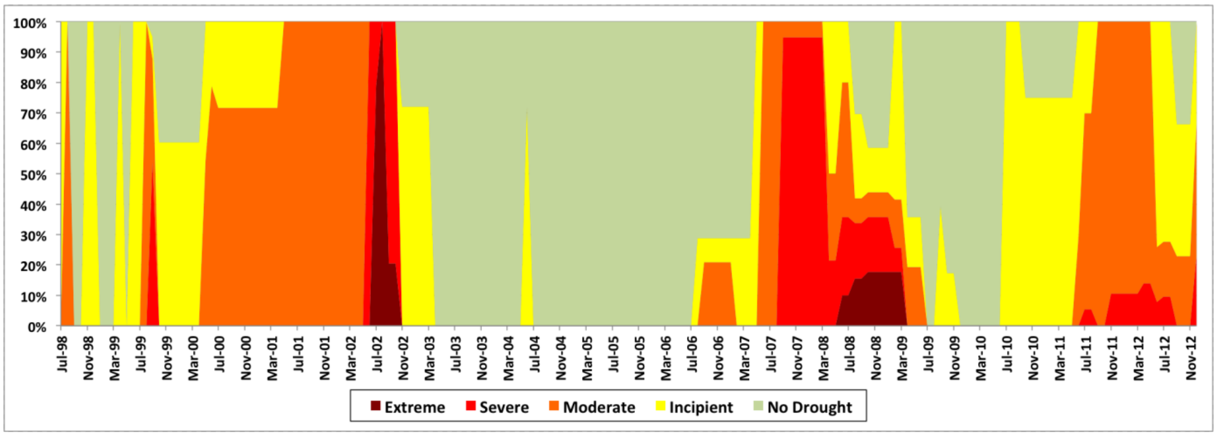


FIGURE 4.H.3—PERCENT AREA OF SOUTH CAROLINA IN DROUGHT BASED ON SC DROUGHT RESPONSE COMMITTEE DROUGHT DECLARATIONS, 1998-2012

TABLE 4.H.2—TEN DRIEST YEARS IN SOUTH CAROLINA SINCE 1895

Year	Annual Amount (in.)	% of Normal
1954	32.06	67.19
1925	35.16	73.69
2001	35.18	73.73
1931	35.7	74.82
2007	36.28	76.04
1933	36.59	76.69
2011	37.95	79.54
1951	38.23	80.12
1911	39.16	82.07
1904	39.76	83.33
Percentages based on 1895-2012 statewide normal of 47.71 (in.)		

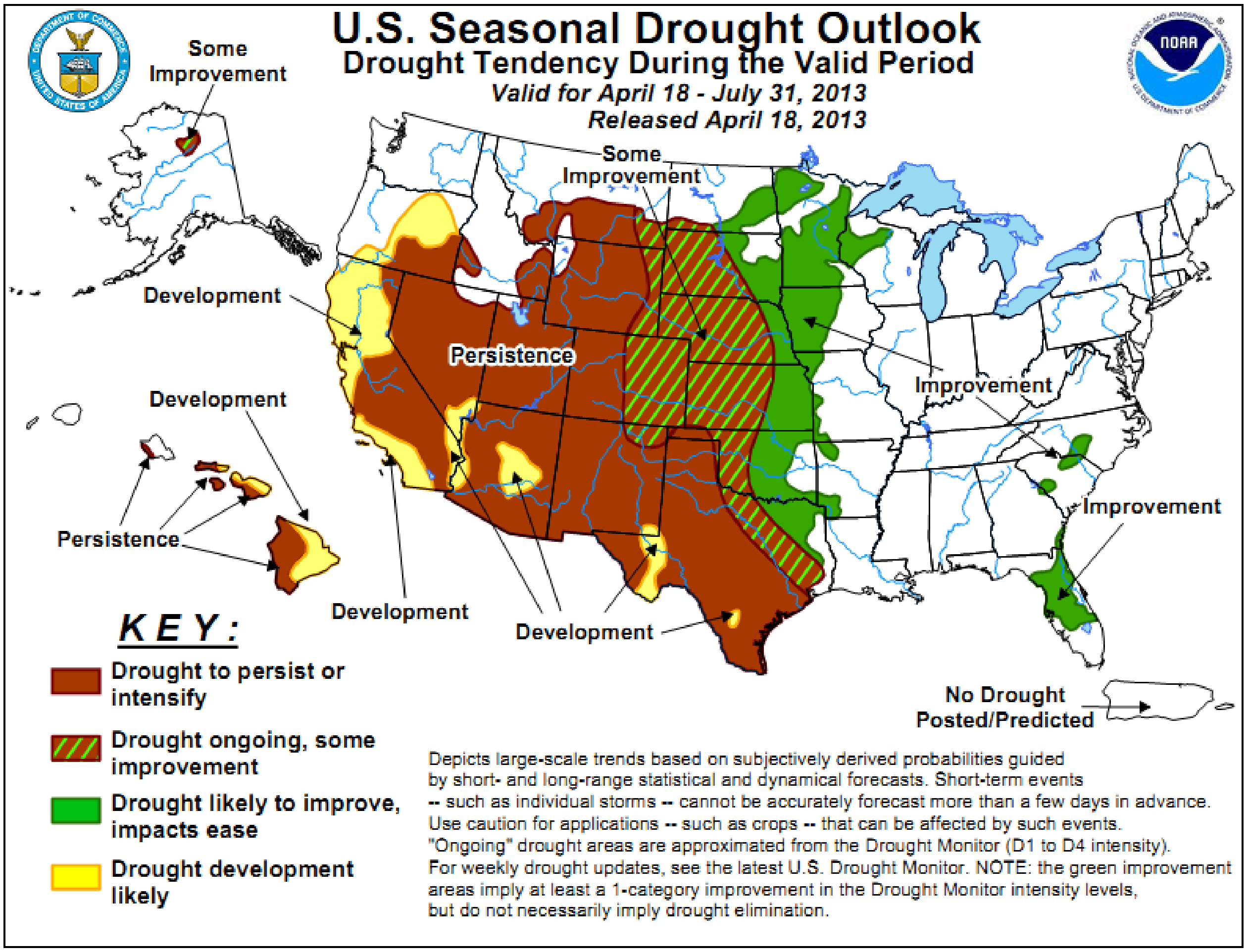


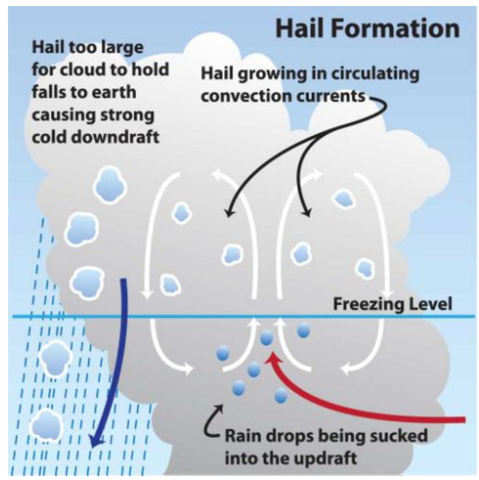
FIGURE 4.H.4—U.S. Seasonal Drought Outlook
Source: NOAA, http://www.cpc.ncep.noaa.gov/products/expert_assessment/seasonal_drought.html

I. HAIL

Hail can occur year-round and can happen anywhere because it derives from severe thunderstorms[61]. It is a precipitation type, consisting of ice pellets that form when updrafts of thunderstorms carry water droplets up into the freezing level of the atmosphere[62]. Hail can be small and generally pea-sized, but hail can also be larger, capable of damaging property and killing livestock and people.

Formation

Initially, water droplets are propelled by updrafts from thunderstorms into the atmosphere, where they freeze. As the droplets collide and combine with other (super-cooled[63]) droplets in the atmosphere, it falls and gets propelled up again to the freezing level, and another layer of ice can form around the original. Eventually, when the hailstone develops sufficient weight to overcome the updraft, it falls towards the ground. The size of hail is a function of the intensity of the updraft and hence, the severity of the storm. Strong vertical motion can keep lifting hailstones so that they continue to accumulate in size[64]. The speed when hail reaches the ground, or its terminal velocity, is a function of its size and weight. However, very rarely does hail reach its maximum terminal velocity due to friction and drag, collision with other droplets, and the hailstones irregular shape.



Source: http://scijinks.jpl.nasa.gov/_media/en/site/rain/hail-formation-large.jpg

Classification

Estimating hail size is generally done through a descriptive comparison to a known object (**Table 4.I.1**).

TABLE 4.I.1—ESTIMATING HAIL DIAMETER

Known-Object	Estimated Hail Diameter (Inch)
Pea	1/4
Marble	1/2
Dime/Penny	3/4
Nickel	7/8
Quarter	1
Ping-Pong Ball	1 1/2
Golf Ball	1 3/4
Tennis Ball	2 1/2
Baseball	2 3/4
Tea Cup	3
Grapefruit	4
Softball	4 1/2

Location

According to historical data collected by the National Climatic Data Center, since 1955 approximately 2.59 hail events occur annually per county. Hail events cannot be predicted as to where they will occur, so for the purpose of this plan, all buildings and facilities are considered to be equally exposed to this hazard.

Historical and Notable Events

April 24, 1999: A super cell thunderstorm moved through Saluda County and produced hail, some as large as baseballs, along its entire path. Homes, buildings, farm equipment, vehicles, and crops were damaged. The thunderstorm, including the associated hail, caused damages across a three-mile wide swath. Property damages were estimated to be $2 million, crop damages were estimated to be $2 million, and two injuries were reported.

May 25, 2000: A severe thunderstorm caused straight-line winds and dime size hail in Darlington, as well as 2-inch hailstones to the south of the city. Property damage was estimated at $150,000. The County Agricultural Service reported several areas of crop damage near Highway 401, estimated at $10,000. In Florence, a severe thunderstorm caused large hail and wind gusts estimated at over 80 mph. The largest hail size was estimated at over four inches in diameter, causing extensive damage to roof and siding. Approximately 2,000 homes were damaged, with repair costs exceeding 6 million dollars. The storm knocked out power to over 20,000 residences. Two injuries were reported due to broken glass impacted by hail.

Recent Activity (2009-2011)

September 27, 2009: Scattered thunderstorms in Chesterfield County produced hail up to the size of nickels, and Cheraw State Park reported penny-sized hail. Property damage estimate for this event is at $4,000.

May 23, 2010: A complex system of thunderstorms moved in to Horry County in the early and late afternoon generated hail of reported up to the size of half dollars. The hail event lasted for about 15 minutes, and property damage estimates are at $244,000.

April 9, 2011: Supercell thunderstorms across the upper Midlands and Pee Dee regions produced hail up to the size of baseballs. Property damage estimates for this significant event is $45 million for across the state.

April 16, 2011: Supercell thunderstorms produced hail and two tornadoes, which knocked down trees in the eastern Midlands and Pee Dee regions. Property estimates for this event is over $210,000.

May 10, 2011: Widespread damaging hail of up to softball-size was reported across eastern and southern South Carolina as a shortwave (middle to upper atmospheric disturbance that creates lift[65]) moved across the area that resulted in scattered thunderstorms. Property damage estimates are at $325,000.

June 15, 2011: A squall line that moved in from Tennessee into the Upstate area caused significant wind and hail damage. Property damage estimates are at $250,000.

Vulnerability

The following section provides information on hazard vulnerability across South Carolina by county. Specifically, this section provides tables and maps to summarize historical and recent hail events (**Figure 4.I.1)** and their associated losses (**Figure 4.I.2)** (property damage, crop damage, fatalities, and injuries). The totals for these losses were calculated from the NCDC Storm Events database and SHELDUS.

Historically, Lancaster County has the highest number of annualized losses, and Spartanburg County has the highest number of hail loss-causing events. Details on historical events and losses for other counties are provided in **Table 4.I.1.**

TABLE 4.I.1—HISTORICAL HAIL EVENTS AND LOSSES

County	HISTORICAL EVENTS (1960-2011)								RECENT EVENTS (2009-2011)					
	Future Probability (% chance per year)	Frequency Interval	Annualized Losses	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Deaths	Injuries	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Recorded Crop Damage	Deaths	Injuries
SPARTANBURG	550.00	0.18	$423,084	286	30	$14,620,527	1	1	44	1	$250,000	$0	0	0
FLORENCE	257.69	0.39	$277,586	134	27	$13,505,692	0	4	9	1	$59,750	$0	0	0
LANCASTER	159.62	0.63	$183,050	83	18	$8,865,779	0	2	7	1	$512,000	$148,000	0	0
NEWBERRY	194.23	0.51	$156,358	101	16	$7,069,371	1	22	7	0	$0	$0	0	0
KERSHAW	211.54	0.47	$132,036	110	20	$4,222,649	0	19	13	1	$460,000	$94,000	0	0
YORK	282.69	0.35	$131,387	147	19	$6,581,253	0	0	27	0	$0	$0	0	0
SALUDA	126.92	0.79	$109,546	66	15	$2,801,971	0	2	7	1	$4,000	$6,000	0	0
FAIRFIELD	138.46	0.72	$88,241	72	16	$2,255,926	2	11	6	1	$75,000	$20,000	0	0
GREENWOOD	240.38	0.42	$70,114	125	19	$3,305,883	0	0	12	0	$0	$0	0	0
HORRY	371.15	0.27	$41,092	193	25	$917,335	0	0	36	2	$480,975	$0	0	0
CHARLESTON	436.54	0.23	$37,589	227	15	$303,281	0	0	38	1	$40,000	$0	0	0
ANDERSON	396.15	0.25	$37,478	206	25	$1,524,857	0	3	28	0	$0	$0	0	0
LAURENS	263.46	0.38	$35,088	137	18	$1,361,104	1	0	26	0	$0	$0	0	0
CHEROKEE	209.62	0.48	$29,836	109	18	$309,373	0	0	9	0	$0	$0	0	0
DARLINGTON	211.54	0.47	$28,862	110	24	$864,461	0	4	7	2	$20,545	$0	0	0
DILLON	144.23	0.69	$28,848	75	22	$404,366	0	0	3	2	$12,150	$0	0	0
GREENVILLE	659.62	0.15	$27,249	343	28	$806,297	1	2	62	0	$0	$0	0	0
OCONEE	303.85	0.33	$24,684	158	18	$784,758	0	0	20	0	$0	$0	0	0
MARLBORO	125.00	0.80	$24,018	65	19	$389,202	0	0	2	1	$1,000	$0	0	0
BEAUFORT	221.15	0.45	$23,987	115	18	$1,120,124	0	0	32	1	$1,500	$0	0	0
SUMTER	225.00	0.44	$20,648	117	19	$598,639	0	10	16	1	$472,000	$109,000	0	0
PICKENS	292.31	0.34	$19,900	152	25	$531,855	0	2	26	0	$0	$0	0	0
MARION	153.85	0.65	$19,879	80	19	$382,547	0	0	3	2	$6,650	$0	0	0
EDGEFIELD	126.92	0.79	$18,593	66	14	$107,908	0	0	4	1	$14,420	$0	0	0
CHESTERFIELD	165.38	0.60	$14,771	86	19	$188,023	0	0	8	2	$64,204	$53,000	0	0
UNION	190.38	0.53	$14,742	99	16	$523,193	0	1	10	0	$0	$0	0	0
CLARENDON	221.15	0.45	$13,779	115	16	$297,506	0	0	9	1	$175,000	$55,000	0	0
ORANGEBURG	363.46	0.28	$13,487	189	22	$368,337	0	0	11	1	$42,000	$20,000	0	0
LEE	132.69	0.75	$13,352	69	18	$370,189	0	0	10	1	$20,000	$15,000	0	0
RICHLAND	355.77	0.28	$12,226	185	20	$382,180	0	2	15	1	$12,000	$8,000	0	0
WILLIAMSBURG	146.15	0.68	$10,933	76	19	$149,078	0	0	7	2	$13,650	$0	0	0
BARNWELL	155.77	0.64	$10,071	81	17	$299,798	0	1	9	1	$0	$8,000	0	0
BAMBERG	150.00	0.67	$9,988	78	15	$244,122	2	1	7	0	$0	$0	0	0
LEXINGTON	469.23	0.21	$9,500	244	20	$255,112	0	0	23	1	$5,000	$2,000	0	0
CALHOUN	153.85	0.65	$9,050	80	15	$129,271	0	0	7	0	$0	$0	0	0
AIKEN	294.23	0.34	$8,653	153	17	$130,976	0	1	11	0	$0	$0	0	0
GEORGETOWN	128.85	0.78	$8,559	67	13	$203,881	0	0	8	2	$85,070	$0	0	0
ABBEVILLE	167.31	0.60	$8,538	87	14	$195,981	0	3	9	0	$0	$0	0	0
BERKELEY	490.38	0.20	$8,204	255	18	$150,148	1	2	44	1	$526	$0	0	0
MCCORMICK	92.31	1.08	$7,977	48	13	$181,228	0	0	7	0	$0	$0	0	0
DORCHESTER	288.46	0.35	$7,793	150	16	$86,364	0	0	24	1	$1,500	$0	0	0
CHESTER	178.85	0.56	$6,664	93	14	$102,400	0	1	16	0	$0	$0	0	0
COLLETON	225.00	0.44	$5,384	117	14	$165,437	0	1	10	0	$0	$0	0	0
ALLENDALE	84.62	1.18	$5,138	44	14	$161,684	0	0	6	0	$0	$0	0	0
HAMPTON	92.31	1.08	$3,833	48	13	$47,999	0	0	3	0	$0	$0	0	0
JASPER	109.62	0.91	$2,650	57	13	$23,276	0	0	11	0	$0	$0	0	0
Grand Total	**10,957.69**	**24.47**	**$2,194,443**	**5,698**	**843**	**$78,291,340**	**7**	**102**	**709**	**33**	**$2,828,940**	**$538,000**	**0**	**0**

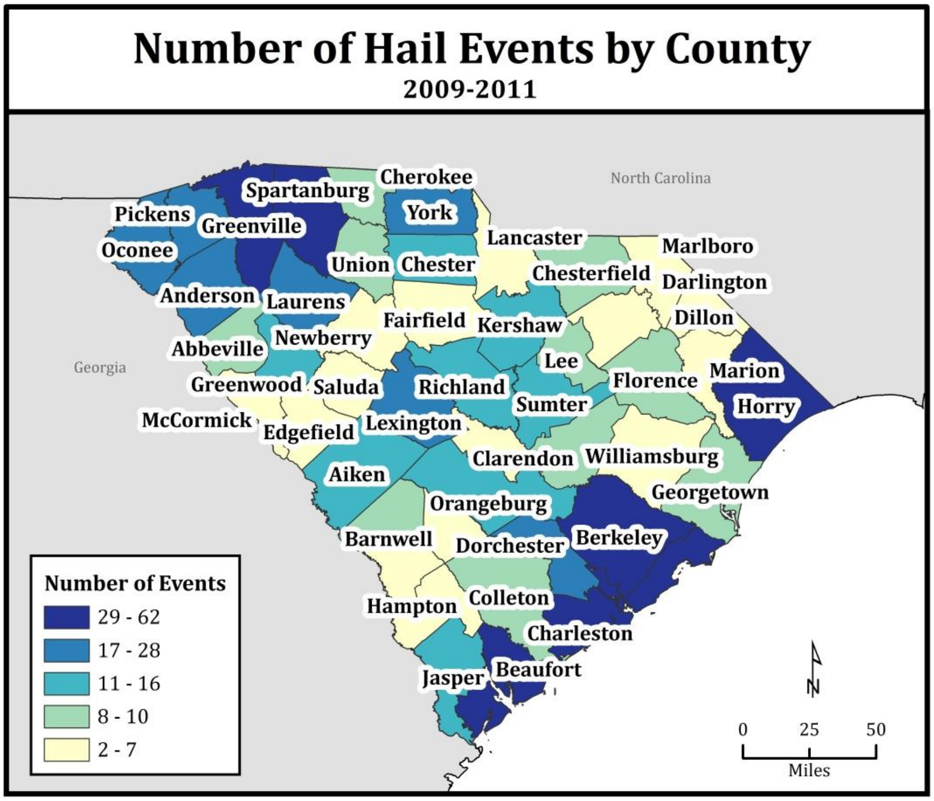


FIGURE 4.I.1—TOTAL HAIL EVENTS

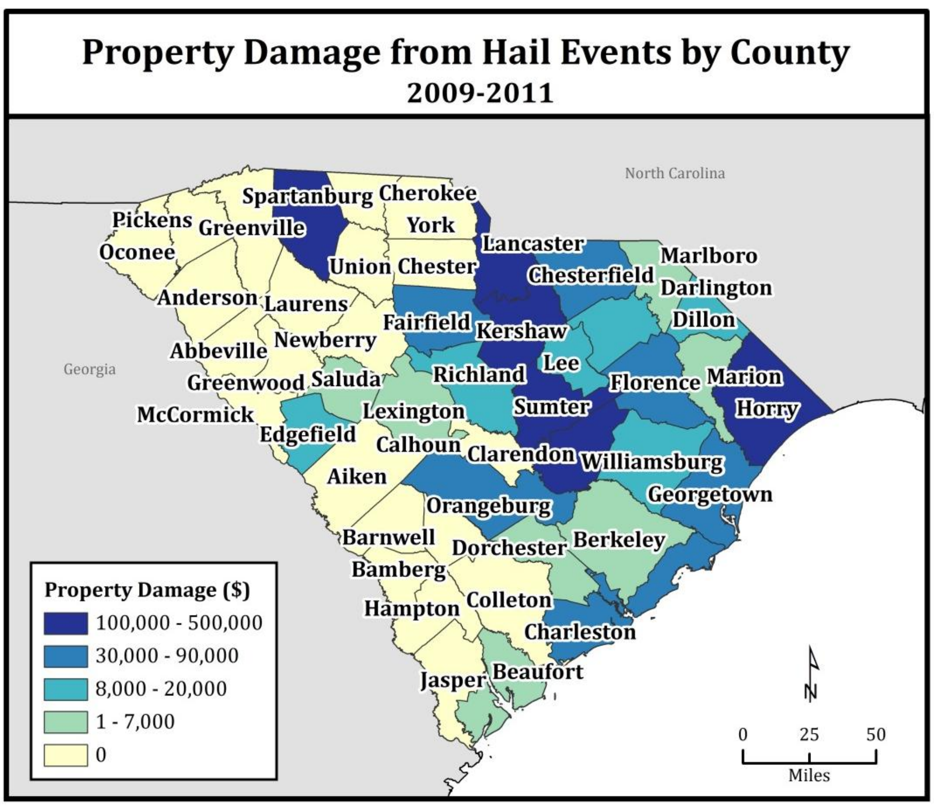


FIGURE 4.I.2—TOTAL HAIL LOSSES

J. WINTER STORMS

Winter storms and winter weather kill dozens of Americans each year, from exposure to cold, from vehicle accidents, from the improper use of heaters, and other winter related incidents[66]. Winter storms are regular occurrences that happen across the country and can take place during spring and fall as well[67]. Many hazards are associated with winter storms and weather including strong winds, extreme cold, coastal flooding, heavy snow and ice storms. Other concerns related to winter weather is power, heat, and communication outages[68].

Formation

There are three components for winter storm formation: cold air, moisture, and lift. Cold temperatures below freezing at ground level allow for snow and ice formation; moisture from bodies of water allows for the precipitation that eventually freezes to snow and ice; lift allows moisture to rise for cloud and precipitation formation.

Classification

Most deaths associated with winter weather and storms are indirectly related, such as fatalities from traffic accidents due to icy conditions, or hypothermia from prolonged exposure.

There is no generally accepted classification of winter storms or destruction, but winter storm types include: blizzard, lake effect, ice storm, and nor'easter[69]. Due to South Carolina's geography and southern location, lake effect snow is not considered.

Blizzard

A blizzard is a winter storm with wind speeds at least 35 miles per hour and low visibility that is reduced to ¼ mile or less for a period of 3 hours or more.

Ice Storm

When freezing rain accumulates to at least ¼ inch or more, it is considered an ice storm. Freezing rain occurs when rain falls onto surfaces with temperatures that are below freezing, thus the rain freezes as ice on contact.

Nor'easter

Nor'easters are very strong winter storms. Strong northeasterly winds blow from the ocean, either formed in the Gulf of Mexico or off the eastern coast in the Atlantic Ocean. Heavy snow, rain, wind, and great waves accompany these storms, often causing beach erosion and structural damage.

Location

Winter storms typically affect a larger geographic area, encompassing multiple counties. While South Carolina does not regularly encounter winter storms but can occur anywhere in the state. For the purpose of this plan, all buildings and facilities are considered to be equally exposed.

Historical and Notable Events

February 8-11, 1973: A snowstorm of historic proportions impacted the state, leaving behind a record 24 inches of snow in some areas. Snowdrifts of up to eight inches were recorded. Approximately 30,000 motorists were stranded on the state's highways—many rescued by helicopter. Eight exposure-related fatalities were reported. Over 200 buildings, in addition to thousands of awnings and carports, collapsed under the weight of the snow. Property and road damages as well as the cost of snow removal and rescue operations were estimated to total approximately $30 million.

March 13, 1993: This winter storm, which possessed an extremely low atmospheric pressure, passed across South Carolina bringing damaging winds, recorded snowfalls of as much as 11.5 feet in portions of the mountains, and snow flurries on the southeast tip of the coast. Preliminary damage assessments at the time were estimated at over $22 million. Two fatalities in South Carolina resulted from this event that is also known as the "Superstorm of the Century"[70]. This historic storm impacted 26 states and broke many historical weather records in the affected areas.

January 22-29, 2000: Low pressure rapidly deepened near the Carolina coast, wrapping abundant moisture back across the Piedmont of the Carolinas. By the time snow ended, accumulations ranged from 12 to 20 inches. Due to the heavy wet snow, numerous power outages occurred and buildings collapsed. On January 29, a weakening low pressure system in the Ohio River Valley, and a low pressure system along the Gulf Coast, coupled with arctic air across the Carolinas, resulted in an icy mess throughout Upstate South Carolina. Precipitation, which briefly began as a light mixture of sleet and snow, quickly turned to freezing rain, resulting in a glaze 1/4 to 1/2 inch thick on exposed surfaces. Power outages were common across the region, especially in the Lower Piedmont from Abbeville to Greenwood. South Carolina requested $9.2 million in federal disaster aid to remove snow and downed trees. A total of 38 counties received a Presidential Disaster Declaration.

December 4, 2002: An ice storm causing $100 million in property damages affected a majority of the counties in the state. Abbeville, Anderson, Cherokee, Chester, Greenville, Oconee, Pickens, Greenwood, Laurens, Spartanburg, Union, and York counties suffered most of the losses from this event, which included ice accumulations up to 1½ inch in some areas. Hundreds of thousands of homes were without power, many for as long as two weeks in some areas.

December 2005: A winter storm producing ice and snow in the upstate counties of Abbeville, Anderson, Cherokee, Chester, Greenville, Laurens, Oconee, Pickens, Spartanburg, Union, and York caused almost $1.5 million in property damage due to power outages and housing unit damage from falling limbs and trees. There were four (indirect) fatalities associated with carbon monoxide poisoning due to indoor generator use in Anderson. This winter storm resulted in a Presidential Disaster Declaration in January 2006. This event was the State's most recent Presidential Disaster Declaration.

Recent Activity (2009 – 2011)

January 29-30, 2010: A winter storm moved up the coast with snow, sleet, and freezing rain, with accumulation primarily in Lancaster, Chesterfield, and Newberry counties. About 1/8th inch of ice was reported for elevated surfaces and trees, and snow was reported to be one to three inches for some counties. Property loss estimates for these three counties total to about $125, 000 dollars. Other counties that received freezing rain and sleet include: Fairfield, Kershaw, Lee, Saluda, Lexington, Richland, Sumter, and Clarendon.

February 12-13, 2010[71]: An area of low pressure moved across the Gulf of Mexico on Friday, the 12th and moved along up the Southeast coast on Friday into Saturday. Cold air was over the Midlands and snow began falling around 4 pm on the 12th and continued into the next morning of the 13th. This significant snowstorm impacted central South Carolina with snow totals ranging from two to eight inches, with the greatest accumulations in the Midlands and Pee-Dee areas. The heavy snow fall caused over 1,500 vehicle accidents and 37,000 homes lost power. Columbia received 8.6 inches of snow from this event, making it the sixth largest snow event in the capital since 1878.

Vulnerability

The following section provides information on hazard vulnerability across South Carolina by county. Specifically, this section provides tables and maps to summarize historical and recent winter storm events (**Figure 4.J.1**) and their associated losses (**Figure 4.J.2**) (property damage, crop damage, fatalities, and injuries). The totals for these losses were calculated from the National Climatic Data Center (NCDC) Storm Events database, and the Spatial Hazard Events and Losses Database for the US (SHELDUS).

Historically, Hampton County has the highest number of annualized losses, and Anderson, Cherokee, Greenville and Spartanburg counties have the highest number of winter storm loss-causing events. Details on historical events and losses for other counties are provided in **Table 4.J.1.**

TABLE 4.J.1—HISTORICAL AND RECENT WINTER STORM EVENTS AND LOSSES

County	HISTORICAL EVENTS (1960-2011)								RECENT EVENTS (2009-2011)					
	Future Probability (% chance per year)	Frequency Interval	Annualized Losses	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Deaths	Injuries	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Recorded Crop Damage	Deaths	Injuries
SPARTANBURG	213.46	0.47	$812,649	111	41	$16,978,979	13	9	9	0	$0	$0	0	0
CHEROKEE	186.54	0.54	$807,027	97	41	$16,868,828	5	3	7	0	$0	$0	0	0
GREENVILLE	259.62	0.39	$691,841	135	41	$16,982,646	14	2	20	0	$0	$0	0	0
UNION	153.85	0.65	$689,592	80	40	$16,549,160	5	2	7	0	$0	$0	0	0
ANDERSON	169.23	0.59	$682,704	88	41	$16,691,113	12	2	6	0	$0	$0	0	0
OCONEE	242.31	0.41	$676,663	126	39	$16,406,764	7	5	19	0	$0	$0	0	0
PICKENS	238.46	0.42	$676,392	124	38	$16,392,940	3	2	16	0	$0	$0	0	0
ABBEVILLE	125.00	0.80	$638,862	65	33	$15,974,403	3	2	5	0	$0	$0	0	0
CHESTER	138.46	0.72	$625,681	72	35	$13,226,281	2	2	5	0	$0	$0	0	0
YORK	159.62	0.63	$625,545	83	36	$13,220,466	5	2	7	0	$0	$0	0	0
LAURENS	151.92	0.66	$477,826	79	39	$5,365,130	3	2	7	0	$0	$0	0	0
HAMPTON	71.15	1.41	$460,360	37	28	$12,753,058	3	1	1	2	$136,300	$0	0	0
DARLINGTON	88.46	1.13	$450,097	46	31	$7,261,242	5	3	5	0	$0	$0	0	0
MARLBORO	98.08	1.02	$441,803	51	33	$6,830,458	2	3	5	0	$0	$0	0	0
DILLON	88.46	1.13	$441,447	46	31	$6,812,345	4	3	5	0	$0	$0	0	0
GREENWOOD	119.23	0.84	$422,197	62	33	$4,707,841	5	2	6	0	$0	$0	0	0
HORRY	65.38	1.53	$389,410	34	26	$6,159,634	5	2	2	0	$0	$0	0	0
FLORENCE	78.85	1.27	$381,645	41	27	$5,755,115	4	1	4	1	$10,300	$0	0	0
WILLIAMSBURG	63.46	1.58	$378,589	33	24	$5,626,883	3	1	2	0	$0	$0	0	0
MARION	75.00	1.33	$371,489	39	27	$5,227,041	4	1	4	1	$0	$0	1	0
FAIRFIELD	107.69	0.93	$366,038	56	35	$2,199,538	5	7	6	1	$10,300	$0	0	0
NEWBERRY	103.85	0.96	$365,842	54	34	$2,196,846	2	6	9	1	$10,300	$0	0	0
LANCASTER	123.08	0.81	$358,723	64	35	$1,819,659	3	9	11	2	$103,000	$0	1	1
CHESTERFIELD	111.54	0.90	$355,693	58	33	$1,664,222	4	7	5	1	$15,450	$0	0	0
KERSHAW	100.00	1.00	$352,659	52	32	$2,194,440	4	8	8	1	$20,600	$0	0	0
BERKELEY	67.31	1.49	$330,731	35	23	$3,085,693	2	1	2	1	$332,857	$0	0	0
SALUDA	76.92	1.30	$321,405	40	26	$1,941,270	2	1	5	0	$0	$0	0	0
MCCORMICK	75.00	1.33	$319,918	39	25	$1,864,324	2	2	4	0	$0	$0	0	0
EDGEFIELD	73.08	1.37	$319,152	38	26	$1,824,464	4	2	5	0	$0	$0	0	0
GEORGETOWN	57.69	1.73	$315,290	30	24	$2,253,974	4	4	1	0	$0	$0	0	0
LEE	80.77	1.24	$308,574	42	27	$1,955,002	2	1	6	1	$15,450	$0	0	0
SUMTER	78.85	1.27	$308,277	41	26	$1,939,552	4	1	6	0	$0	$0	0	0
CLARENDON	71.15	1.41	$308,045	37	25	$1,928,321	4	1	4	0	$0	$0	0	0
RICHLAND	80.77	1.24	$307,760	42	27	$1,912,740	6	1	7	0	$0	$0	0	0
DORCHESTER	73.08	1.37	$307,073	38	24	$1,855,470	2	1	4	0	$0	$0	0	0
LEXINGTON	80.77	1.24	$307,034	42	25	$1,902,962	3	1	8	0	$0	$0	0	0
CALHOUN	65.38	1.53	$306,892	34	24	$1,898,197	2	1	3	0	$0	$0	0	0
BAMBERG	61.54	1.63	$305,836	32	23	$1,843,723	2	1	2	0	$0	$0	0	0
ORANGEBURG	61.54	1.63	$305,836	32	24	$1,843,723	5	1	2	0	$0	$0	0	0
ALLENDALE	63.46	1.58	$299,554	33	25	$1,465,010	2	1	1	1	$89,000	$0	0	0
AIKEN	65.38	1.53	$295,911	34	23	$1,327,702	4	1	5	0	$0	$0	0	0
BARNWELL	59.62	1.68	$295,911	31	23	$1,327,702	2	1	2	0	$0	$0	0	0
COLLETON	78.85	1.27	$271,864	41	27	$2,953,208	3	1	4	2	$80,090	$0	0	0
CHARLESTON	76.92	1.30	$262,787	40	27	$2,481,753	14	1	4	2	$212,333	$0	0	0
BEAUFORT	57.69	1.73	$258,487	30	24	$2,310,665	3	1	1	1	$10,300	$0	0	0
JASPER	61.54	1.63	$258,385	32	24	$2,305,365	2	1	2	1	$5,000	$0	0	0
Grand Total	**1,965.38**	**52.57**	**$19,255,498**	**2,496**	**1,375**	**$278,085,854**	**191**	**111**	**86**	**19**	**$1,051,280**	**$0**	**1**	**1**

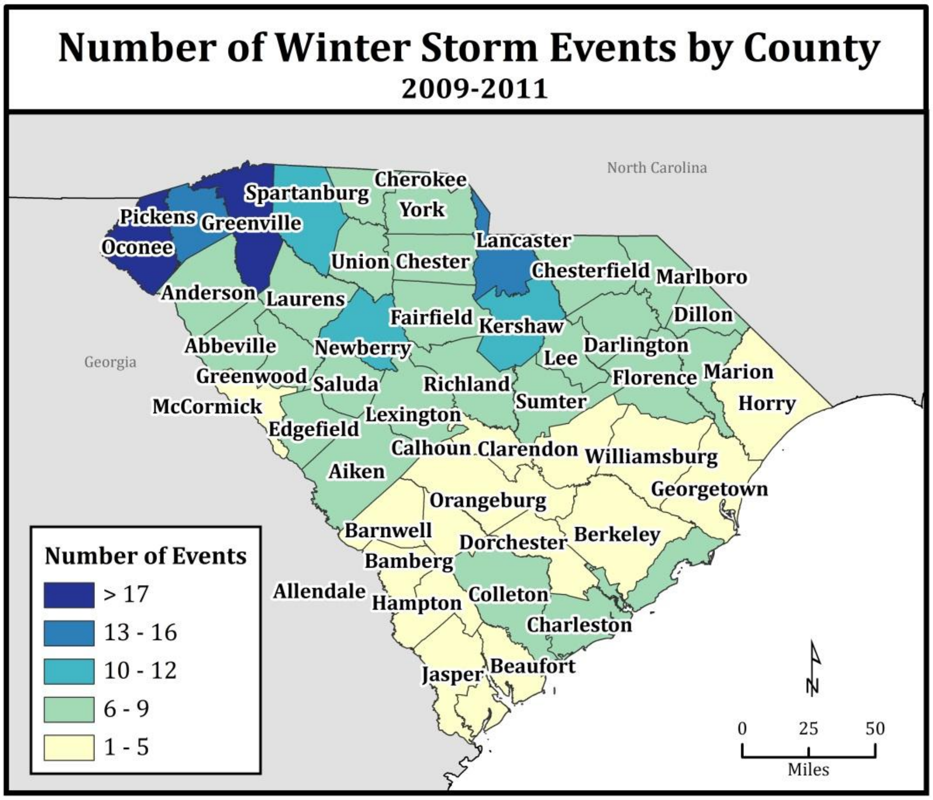


FIGURE 4.J.1—TOTAL WINTER STORM EVENTS

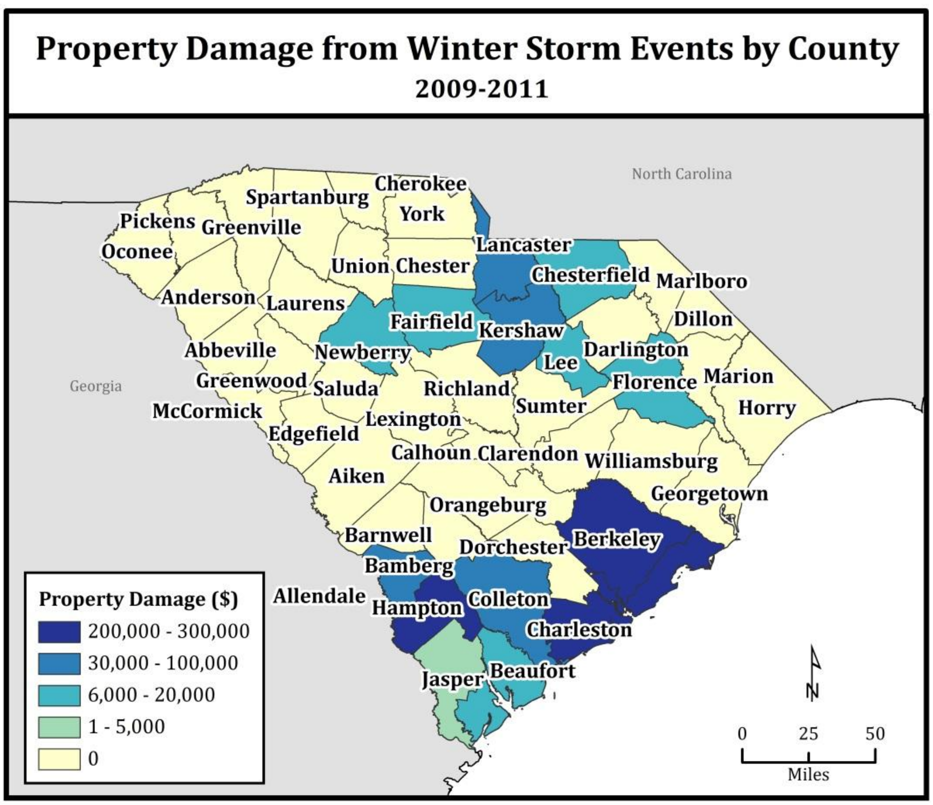


FIGURE 4.J.2—TOTAL WINTER STORM LOSSES

K. EARTHQUAKE

An earthquake is ground motion produced by the energy released from sudden displacement of rock in the Earth's crust. Annually in South Carolina, there are about 10 to 15 earthquakes recorded, with only 3-5 actually noticed by people[72]. Because of this low frequency of noticeable events, many people are unaware of the earthquake risk in South Carolina. However, all 46 counties in the state are susceptible to effects of earthquakes. About 70 percent of earthquake activity in the state is located in the Middleton Place-Summerville Seismic Zone. This zone is located about 12 miles northwest of Charleston and is the most active zone in South Carolina[73], experiencing 10 to 15 earthquakes (magnitude 3 or less) a year[74].

Formation

Earthquakes are caused by the sudden movement of rock beneath the earth surface. Stress built up in the Earth's crust causes rocks near the surface to break and slip, and when this occurs, an earthquake results. This region along which the slip occurs at the Earth's surface is called a fault[75]. Earthquakes occur along faults, tectonic plate boundaries, and mid-oceanic ridges (underwater mountain range)[76]. There are three types of faults (**Figure 4.K.1**): strike-slip (rock blocks move horizontally), normal (rock moves down relative to the other side), and thrust (rock moves up relative to the other side)[77]. The majority of earthquakes occur along tectonic plate boundaries, known as interplate earthquakes.

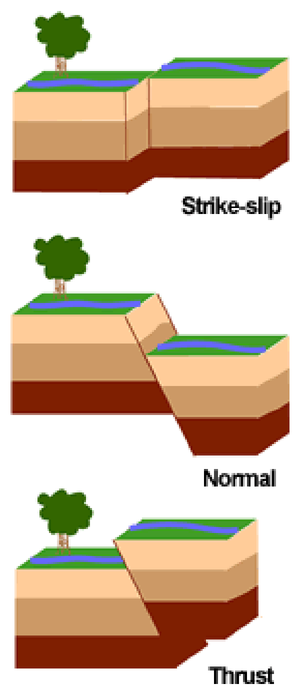


FIGURE K.1— EARTHQUAKE FAULTS
Source: USGS

Classification

Energy is released when an earthquake occurs, (P and S waves) which result in the shaking people feel and that which is detectable by seismic instruments[78]. The point below the surface, within the Earth's crust where an earthquake begins is called the hypocenter or focus, and the point directly above this depth on the Earth's surface is the epicenter.

Earthquakes can affect hundreds of thousands of square miles, cause billions of dollars of property damage (primarily due to failure and collapse of structures from ground shaking), result in the loss of life and injury to thousands of people, and disrupt the social and economic functioning of the affected area. Aftershocks are smaller earthquakes which may occur after the initial main shock and can also cause considerable damage[79]. The level of damage depends upon the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, time of occurrence (greater fatalities tend to occur during weekday work hours when more people are in large office buildings or schools), site and soil type. Strength of shock waves diminish from the focus, thus greater distance from the earthquake origin will decrease likelihood or extent of damage. Other damaging earthquake effects include landslides, and liquefaction, in which ground soil loses the ability to resist shear and flows, much like quick sand. In the case of liquefaction, anything relying on the substrata for support can shift, tilt, rupture, or collapse. In urban areas, damage to electric and gas lines may lead to the common occurrence of local fires. Earthquakes that trigger movement of the seafloor may also generate tsunamis.

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude (**Table 4.K.1**). Each unit increase in magnitude on the Richter Scale corresponds to a ten-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, with a I corresponding to imperceptible (instrumental) events, IV corresponding to moderate (felt by people awake), to XII for catastrophic (total destruction). A detailed description of the Modified Mercalli Intensity Scale of earthquake intensity and its correspondence to the Richter Scale is provided in **Table 4.K.2.** A projected earthquake intensity map produced by South Carolina Department of Natural Resources is shown in **Figure 4.K.2**. This intensity is based on the Modified Mercalli Intensity Scale and shows likely intensities under a combined condition of the 1886 Charleston earthquake and then January 1913 Union County earthquake.

TABLE 4.K.1—RICHTER SCALE AND EFFECT

MAGNITUDE	DESCRIPTION OF EFFECTS
Less than 3.5	May or may not be detectable by people, recorded by instruments
3.5-5.4	Often felt, dishes break, doors and windows rattle
Under 6.0	Slight damage to buildings
6.1-6.9	Moderate damage to buildings
7.0-7.9	Serious damage, buildings may collapse, loss of life
8 or Greater	A great earthquake that causes total damage and great loss of life

Source: FEMA, and http://schools.matter.org.uk/content/Seismology/richterscale.html

TABLE 4.K.2—MODIFIED MERCALLI INTENSITY SCALE

SCALE	DESCRIPTION OF EFFECTS
I	Only detectable by instruments
II	Felt by some people, especially if on higher floors, some objects may swing
III	Felt indoors, feels like a truck rumbling by
IV	Felt indoors by many people, felt by some outdoors, dishes and doors may move
V	Felt by most people, some dishes and windows break, objects fall
VI	Felt by everyone, may move heavy furniture, slight damage
VII	Slight to moderate damage in ordinary-built structures, great damage in poorly built structures
VIII	Considerable damage in ordinary-built structures, chimneys, columns, walls fall
IX	Great damage, buildings may shift from foundation
X	Most masonry and frame structures collapse, rails bent
XI	Few buildings remain, bridges collapse and rails damaged
XII	Total destruction, lines of sight distorted

Source: USGS, www.earthquake.usgs.gov

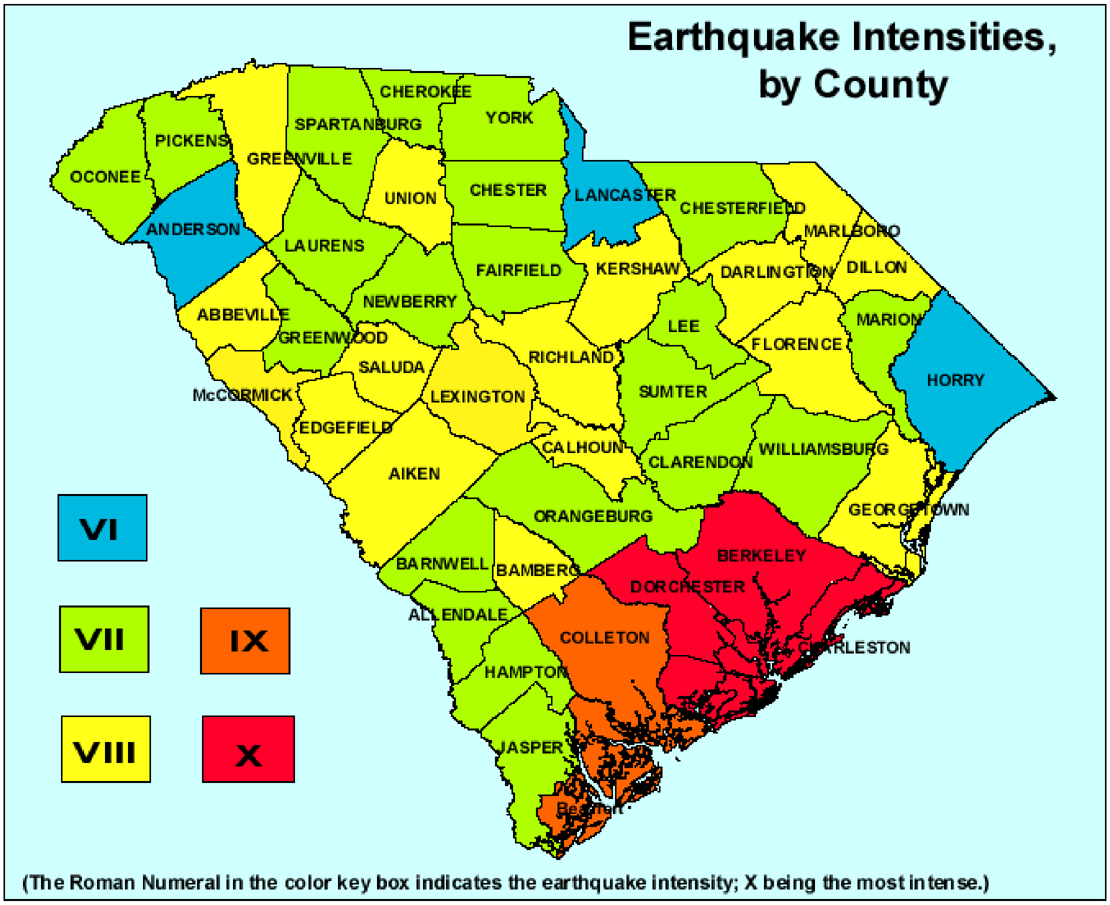


FIGURE 4.K.2—ESTIMATED EARTHQUAKE INTENSITY
Source: SCDNR

Location

South Carolina is located in the interior of the North American plate, and earthquakes that occur within a plate are called intraplate earthquakes (37-SCEMD). Earthquake activity in South Carolina fall under three main causes: fault activity, reservoir induced seismicity, and Appalachian rise. A map showing the fault system in South Carolina is shown in **Figure 4.K.3**. Reservoir induced seismicity occurs when man-made lakes and dams cause water-pore pressure to increase, thereby reducing the strength of the underlying rock and allowing the rock to slip. Lastly, geological activity erodes and weathers the Appalachian Mountains, removing weight from the land and causing the mountains to slowly rise. These movements cause the earthquake activity in the upstate. The following paragraphs discuss the earthquake risks shown in **Figure 4.K.4.** The seismic characteristics of the state are show in **Figure 4.K.5,** and **Figure 4.K.6.** **Figure 4.K.7** depicts potential ground movement from an earthquake.

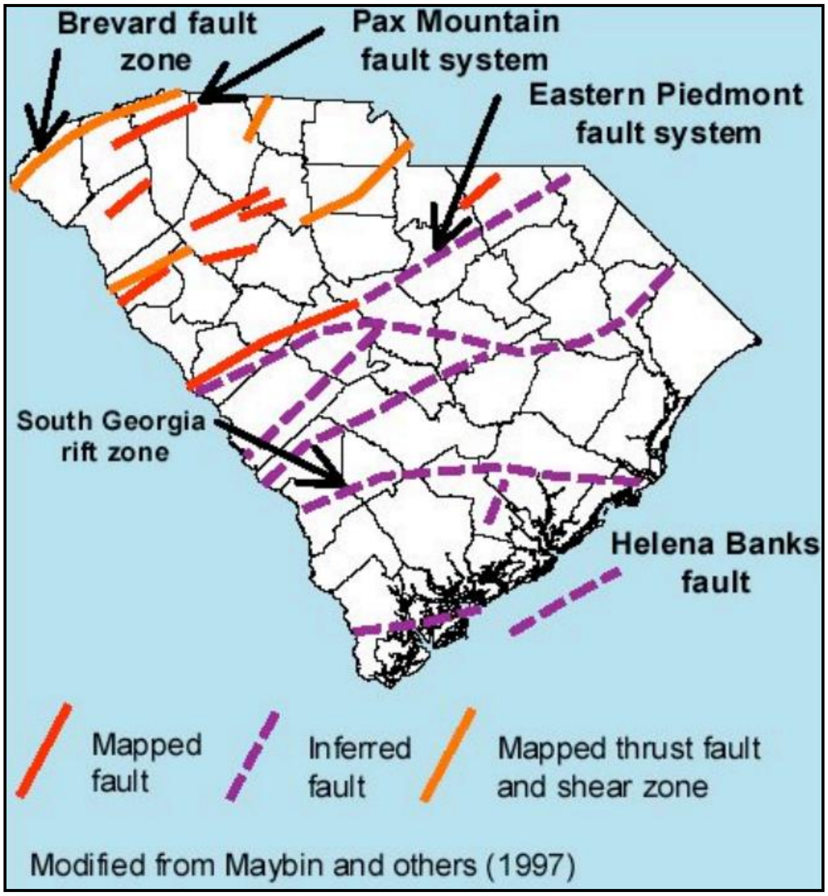


FIGURE 4.K.3—FAULT SYSTEM OF SOUTH CAROLINA
Source: SCDNR

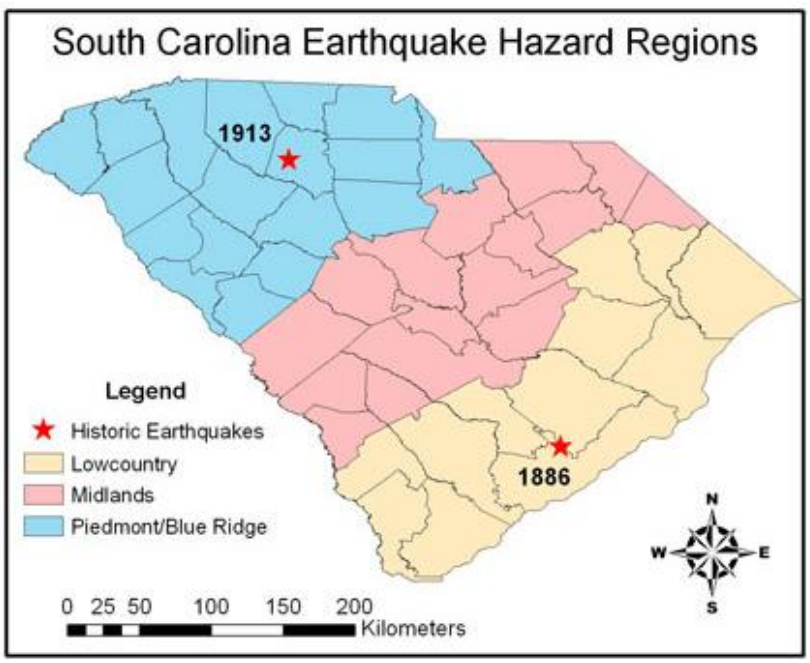


FIGURE 4.K.4—EARTHQUAKE REGIONS AND MAJOR HISTORIC EPICENTERS
Source: South Carolina Earthquake Education and Preparedness Program

Lowcountry – The coastal counties in the coastal plain consist primarily of young (<2 million years) surficial sediments. Areas of potential activity include the Summerville/Middleton Place area (1886 earthquake location), and places near Georgetown and Bluffton (based on paleo-liquefaction evidence). Along the coastline, there is a high liquefaction and tsunami hazard potential. Counties include: Horry, Georgetown, Charleston, Berkeley, Dorchester, Beaufort, Jasper, Marion, Williamsburg, Colleton, Hampton, and Florence.

Earthquake Risk – Talwani and Schaeffer (2001) from the University of South Carolina used evidence from previous earthquakes to determine how often earthquakes like the 1886 earthquake have occurred in the Charleston/Coastal area. They determined that earthquakes in the Charleston area appear to occur about every 400-500 years and the possibility that large earthquakes may occur in Georgetown and Bluffton on average 2000 year cycles. Unfortunately, their data set is limited to only the last 6000 years because of changes in groundwater levels, which affect the formation of earthquake features. Therefore, it seems unlikely that a large earthquake will occur anytime soon in the Lowcountry. Statistically, there is a 1/400 chance that a large earthquake will occur each year. Smaller (<5.5-6) earthquakes don't tend to leave much evidence behind for scientists to find later, so it is unclear how often these occur in this area. This region has a thick layer of sediment cover with a predominantly swampy characteristic, therefore earthquakes that do occur here will have more shaking than in the other two regions.

Midlands – This region includes the counties on the coastal plain with older (> 2 million years) surficial sediments. This region includes the Fall Line as a potential earthquake source. Dams here have also been known to have caused earthquakes. Counties in this region include: Dillon, Marlboro, Chesterfield, Darlington, Lee, Kershaw, Clarendon, Sumter, Richland, Calhoun, Orangeburg, Lexington, Aiken, Barnwell, Bamberg, and Allendale.

Earthquake Risk – The Midlands area is not known to have experienced any large earthquakes in the past. The Fall Line in South Carolina represents a change in geology makeup and is the location of a large fault system that stretches across the state. Until recently, this area was thought to be relatively inactive until recent activity indicated that this may be a mildly active fault. Historical earthquakes in the Midlands have been small (magnitude 2-4) and have caused minimal damage. Two earthquakes near Florence in the fall of 2006 caused minor damage to homes that are located on weaker soils and swampy lands. The thin layer of loose sediment in the Midlands, especially around the swampy areas can increase the amplitude of earthquake waves and increase the shaking felt.

Piedmont/Blue Ridge – The counties in this region overlay almost entirely igneous/metamorphic basement rock with local river alluvium and weathered bedrock cover. The 1913 Union County earthquake occurred within this region. Counties here include: Oconee, Pickens, Anderson, Greenville, Spartanburg, Cherokee, Union, York, Chester, Laurens, Newberry, Fairfield, Lancaster, Abbeville, Greenwood, McCormick, Saluda, and Edgefield.

Earthquake Risk – Generally, the Piedmont/Blue Ridge and Midlands section of South Carolina are considered at a low risk of major (magnitude 6+) earthquakes. However, in 1913 Union County South Carolina experienced an earthquake that by today's standards would probably be measured as a 5.5 on the Richter scale. Not much is known about the cause of the Union County earthquake because of the lack of technology at the time, but at the present, the risk of a major earthquake is considered to be low. The Piedmont/Blue Ridge area is also susceptible to smaller earthquakes (magnitude 2-4) in other locations, especially near dams. The USC seismic stations have recorded numerous small earthquakes associated with dams in the Piedmont/Blue Ridge area and some smaller earthquakes distributed around the area. These small earthquakes not associated with dams may be associated with the uplift of the Appalachian Mountains as is seen in other areas near the mountains. Earthquakes in this region are likely to be felt over large areas because of the relatively unbroken mass of rock they occur in. This allows earthquake waves to travel long distances before they become attenuated and are no longer felt. Because most buildings are built on solid rock, earthquakes will cause less damage than earthquakes in the Lowcountry because solid rock does not increase the amplitude of earthquake waves, whereas loose sediment can increase the shaking by increasing the amplitude of the waves.

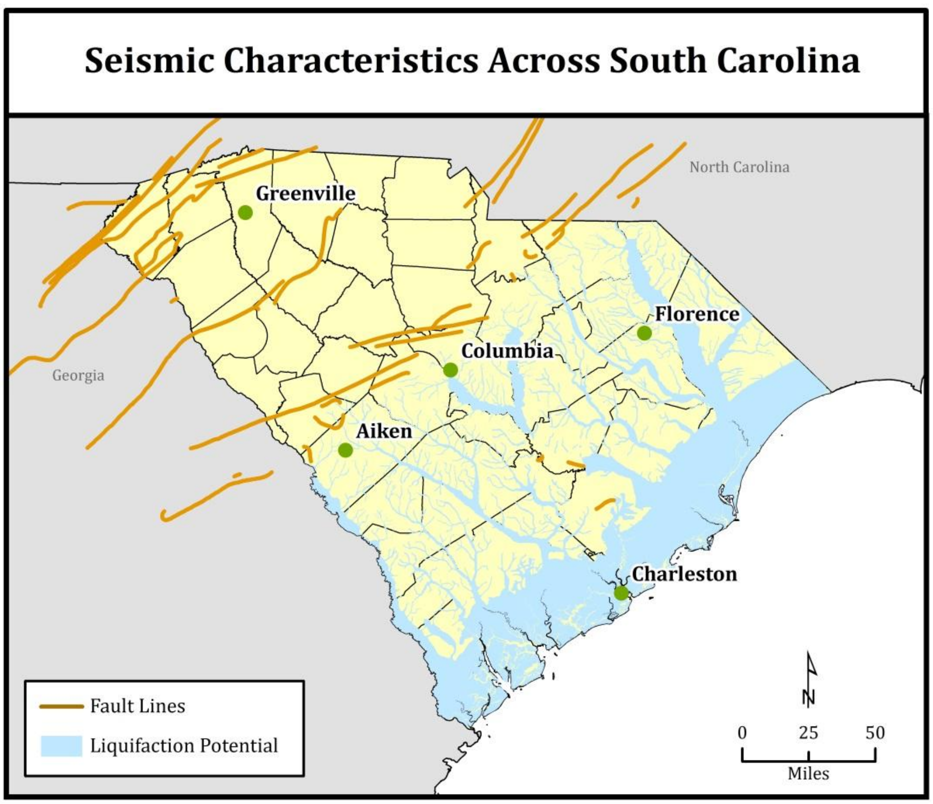


FIGURE 4.K.5—BASIC SEISMIC CHARACTERISITCS

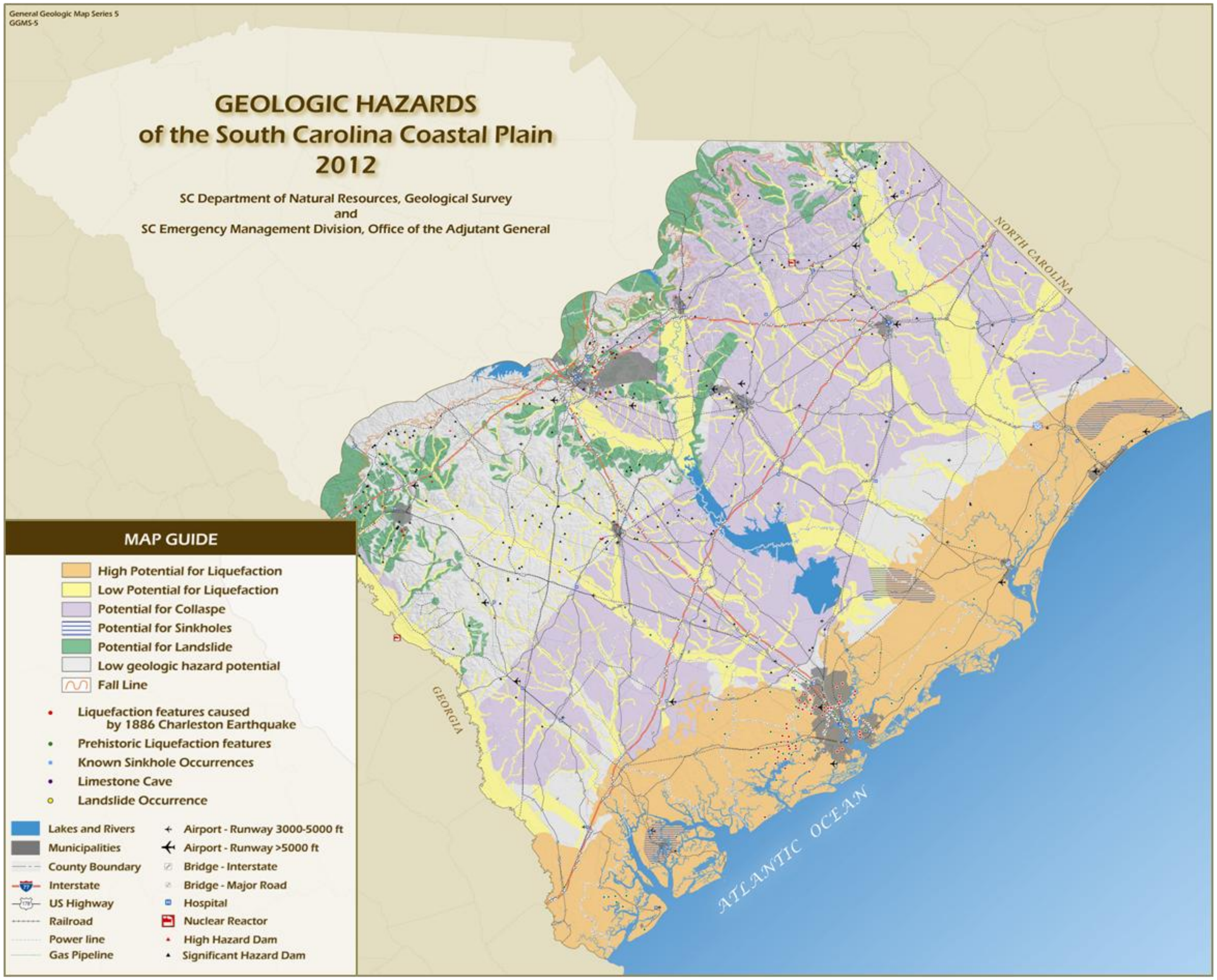


FIGURE 4.K.6—GEOLOGIC HAZARDS OF SOUTH CAROLINA, SCDNR & SCEMD

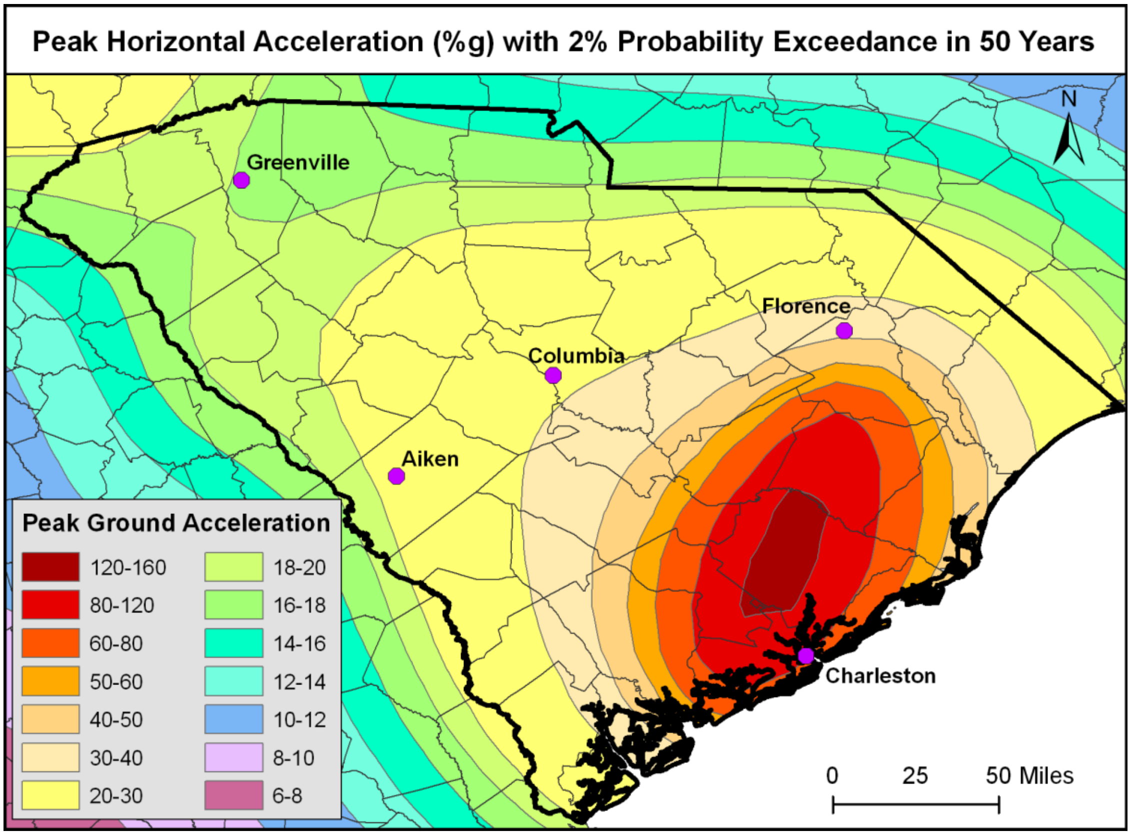


FIGURE 4.K.7—POTENTIAL GROUND MOVEMENT
Source: Hazus-MH

Historical and Notable Events

August 31, 1886: One of the greatest earthquakes in the United States occurred in Charleston on August 31, 1886, with an intensity of X on the Modified Mercalli Scale. This event killed over 70 people and left most structures damaged or destroyed, with an estimated damage of $23 million. The initial shock occurred at 9:51 p.m. and lasted between 35 to 40 seconds. There was a second strong aftershock 8 minutes after the initial shock, and six aftershocks followed within a 24 hour period. Within a 160 kilometer radius, cities of Columbia, South Carolina, Savannah and Augusta, Georgia also experienced damage. The total affected area covered over 5 million square kilometers, and was felt in cities of New York, Boston, Milwaukee. Cuba, Bermuda, and Ontario, Canada also felt the main earthquake[80].

On **June 12, 1912** and **January 1, 1913**, two earthquakes occurred in Union County, South Carolina. The second was felt from Georgia to Virginia. Witnesses report the earthquake was accompanied by a loud roaring noise. A house in Union County and chimneys in Union, Spartanburg, and Cherokee Counties were destroyed. The shock was felt for more than 30 seconds in Raleigh, North Carolina. Isoseismals (lines on a map showing areas with equal seismic intensities) showed an elliptical area of approximately 43,000 square miles that felt the

disturbance. Although only minor damage occurred, the intensity of the earthquake was a VII and is the largest know earthquake to have occurred in South Carolina outside of the Charleston area.
From 1989–1993 an increase in earthquake activity was noted. Seismologists consider almost half of South Carolina counties as being at high risk for seismic events because of the state's seismic history and current seismic activity. In 2002, 17 earthquake events were recorded in the Middleton Place-Summerville Seismic Zone (MPSSZ), which is located approximately 13 miles northwest of Charleston, with magnitudes ranging from 0.68 to 3.03. In addition, two earthquakes occurred on the continental shelf approximately 16 miles offshore of Seabrook and Kiawah Islands. The offshore earthquake recorded on November 11, 2002 had a magnitude of 4.32 and was felt over a wide area from Wilmington, North Carolina, south to Savannah, Georgia, and inland to areas around Columbia. Fortunately, there were no reports of damage associated with this event. Between 2002 and 2005, there were no major earthquakes.

Recent Activity (2009-2011)

There have not been any major earthquakes since 2009. Numerous minor earthquakes have been registered, including eight in 2009, two in 2010, and ten in 2011. The highest of these registered earthquakes is a 3.2 on the Richter Scale that originated around Summerville, Dorchester County. The August 23, 2011 major earthquake in central Virginia was felt widespread in South Carolina, with reports of buildings shaking in Greenville, Georgetown, Myrtle Beach, and Rock Hill. Several buildings in downtown Columbia were evacuated; this was a Magnitude 5.8 event81.

Vulnerability

In order to conduct the risk assessment, Hazus-MH, FEMA's loss estimation software was used to model and provide estimates of potential impact. Hazus-MH risk assessment method is parametric in that distinct hazard and inventory *parameters* (for example, soil and liquefaction data, and building types) were modeled using the Hazus-MH software to determine the impact (damages and losses) on the built environment. The Hazus-MH software was used to estimate losses from earthquake hazards. The baseline data in Hazus continually undergoes updates, such as our essential facility data update in 2009. **Table 4.K.17** does not include the same information as the other hazard tables of historical events and loss information. This is due to inconsistencies and incomplete earthquake information from SHELDUS and NCDC. Annualized losses for earthquakes were modeled in Hazus-MH, and earthquake events were taken from South Carolina's Seismic Network and the period of record of events is for 313 years.

100 and 500 Year EQ Scenarios:

A Hazus probabilistic scenario of a 100 (500) year earthquake with a 5.3 (7.3) magnitude event was performed to determine the annualized losses that could be expected to occur statewide. The total estimated economic loss for this earthquake is $4,270,000 (3,260,100,000), which includes building, and lifelines. **Figure 4.K.8** (**Figure 4.K.9**) shows where state-owned buildings are in relations to the 100-year modeled earthquake hazard zone. The following provides detail to estimated damages.

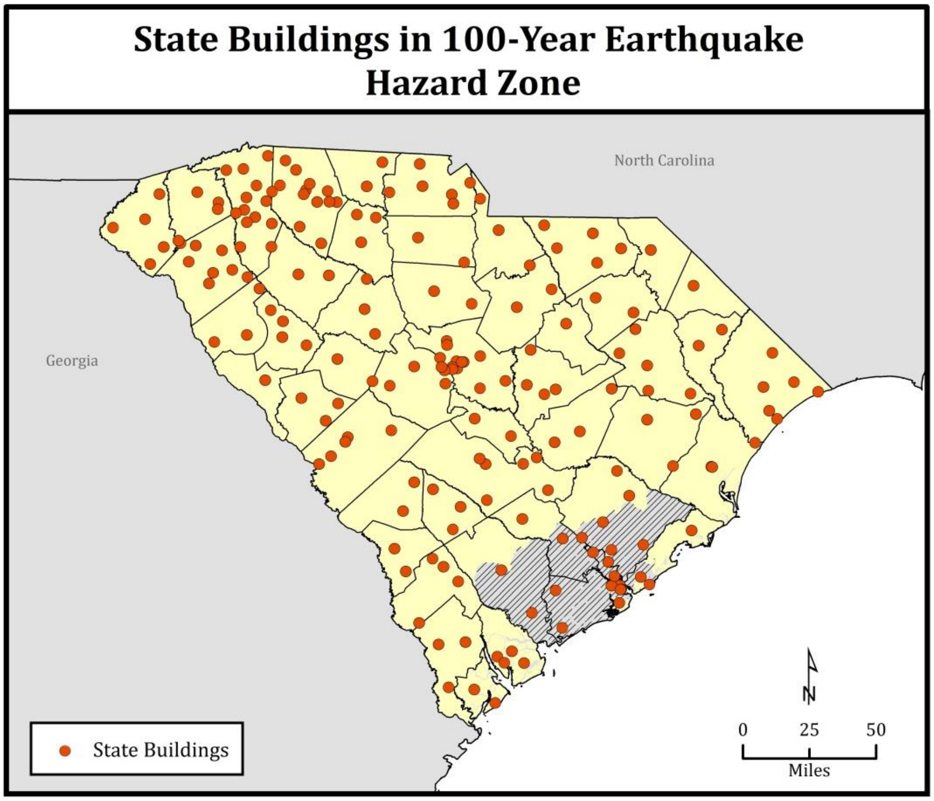


FIGURE 4.K.8—STATE-OWNED BUILDINGS IN 100-YEAR EARTHQUAKE HAZARD ZONE

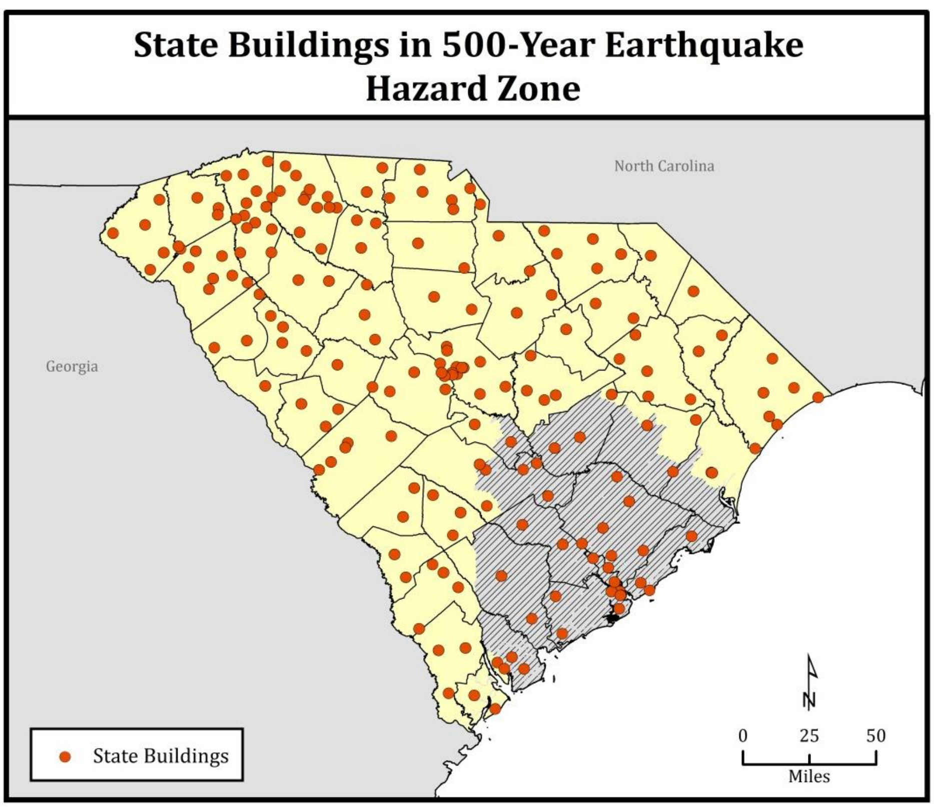


FIGURE 4.K.9—STATE-OWNED BUILDINGS IN 500-YEAR EARTHQUAKE HAZARD ZONE

Following the 100 year earthquake scenarios are similar tables, but modeled for a 500 year 7.3 magnitude earthquake event. Numbers in ( ) are the values for the modeled 500 scenario.

Buildings: Hazus estimates that there are 1,832,000 buildings in the state with a total replacement value of $248,996,000,000. According to the results of this analysis, 94 (54,700) buildings will sustain at least moderate damage. Zero (544) buildings are expected to have damage beyond repair. **Table 4.K.3** (**Table 4.K.4**) summarizes expected damage based on general building type. **Table 4.K.5** (**Table 4.K.6**) provides detail on monetary building economic losses as comprised of direct building and income losses. Direct building losses are the estimated costs to repair or replace the damage and income losses result from the inability to continue business operations because of sustained damages. **Figure 4.K.10** (**Figure 4.K.11**) show the total direct building economic loss for the state.

Essential Facilities: Hazus provides estimated damage to essential facilities in **Table 4.K.7** (**Table 4.K.8**), which include hospitals, schools, police and fire stations, and emergency operations facilities (EOC). Before the earthquake, the state had 14,840 hospital beds. The model estimates that 14,646 (11,302) hospital beds remain available in use. After one week, 100% (89%) will be available for use, and by 30 days, 100% (97%) will be operational.

Transportation and Utility Lifeline: The total value of the lifeline inventory is more than $115,835,000,000. This includes over 8,000 miles of highways, 9,957 bridges, and over 28,700 miles of pipes. **Table 4.K.9** (**Table 4.K.10**) provides information on damages and **Table 4.K.11** (**Table 4.K.12**) provides estimated losses to transportation, while **Table 4.K.13** (**Table 4.K.14**) provides estimated damages to utility lifelines.

Debris: The model estimates that 0.00 (1.05) million tons of debris will be generated, with 81% (63%) comprised of brick and wood debris, and the remainder being reinforced concrete and steel. The model also indicates that it will require 80 (42,160) truckloads to remove the debris.

Shelter: Hazus estimates the number of households who are expected to be displaced from their homes and will require temporary public shelters for this earthquake event. The model estimates that 1 (1,699) households will be displaced and 1 (1,258) person will seek temporary shelter.

Casualties: Hazus breaks down casualties, as shown in **Table 4.K.15** (**Table 4.K.16**) into 4 severity levels that relate to the extent of injuries. It also breaks down casualty estimates for three different times of the day for different settings that consider peak occupancy. For example, at 2 AM, generally the peak occupancy of people will be in a residential setting.

- Level 1: Require medical attention, but not hospitalization.
- Level 2: Require hospitalization but injuries are not life-threatening.
- Level 3: Require hospitalization, injuries can be life threatening if not treated immediately.
- Level 4: Victims killed

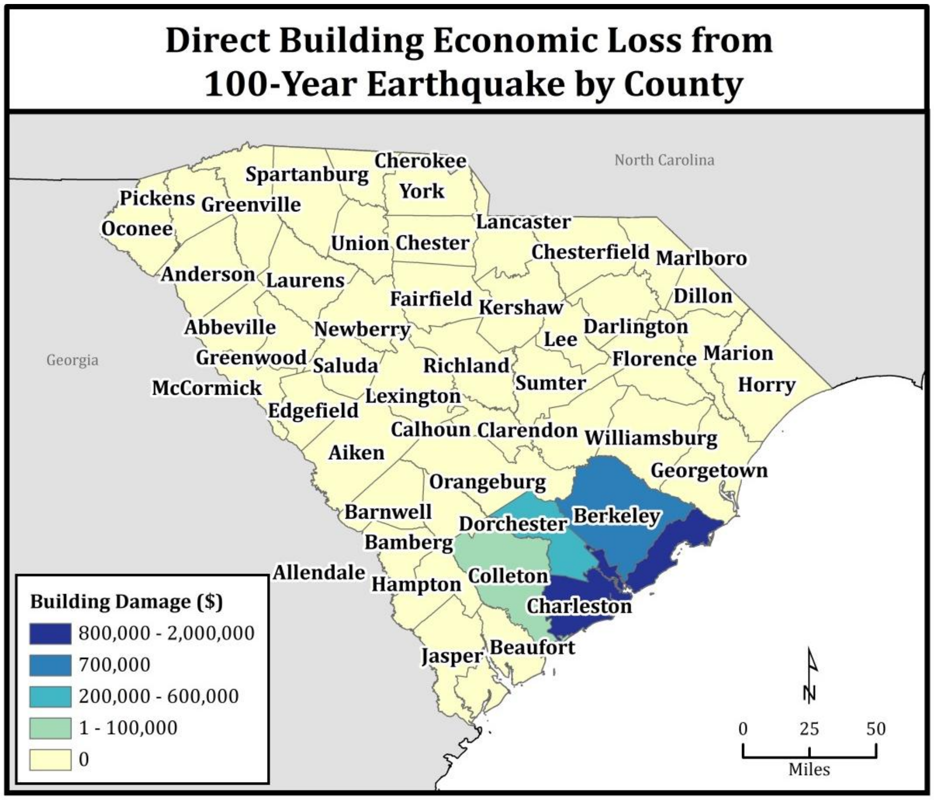


FIGURE 4.K.10—TOTAL DIRECT BUILDING ECONOMIC LOSS FOR 100-YEAR EARTHQUAKE

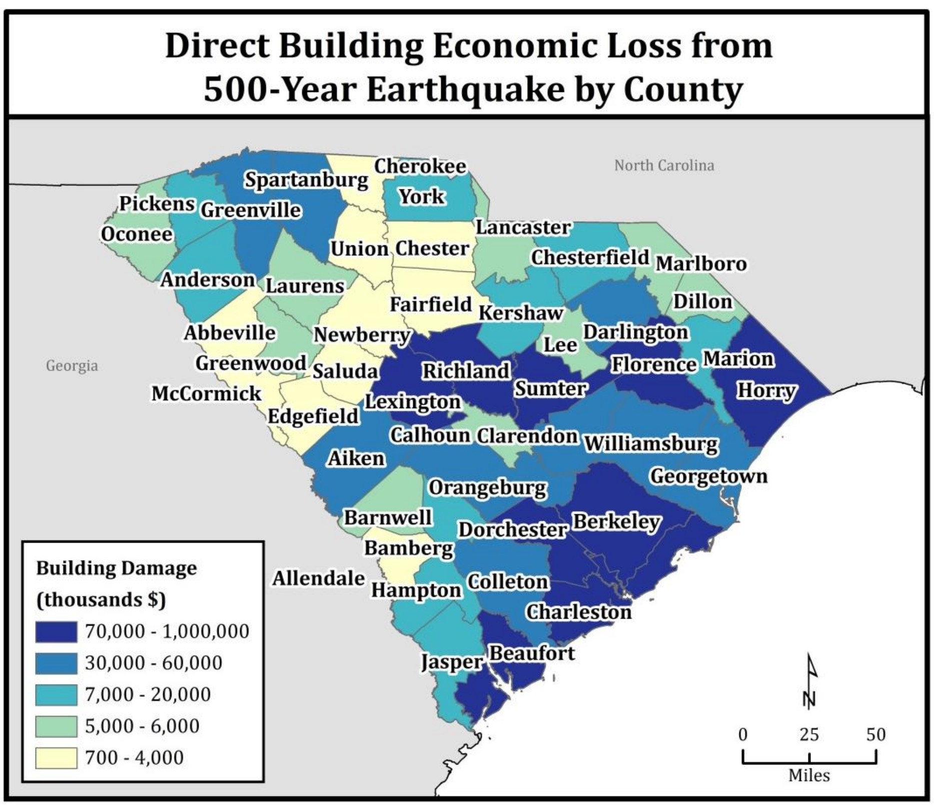


FIGURE 4.K.11—TOTAL DIRECT BUILDING ECONOMIC LOSS FOR 500-YEAR EARTHQUAKE

TABLE 4.K.3—100-YEAR EQ EXPECTED DAMAGE BY BUILDING OCCUPANCY

	None		Slight		Moderate		Extensive		Complete	
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	6,323	0.35	2	0.39	0	0.35	0	0.60	0	0.32
Commercial	87,792	4.79	34	7.76	7	7.89	1	14.50	0	11.25
Education	2,975	0.16	1	0.23	0	0.21	0	0.37	0	0.37
Government	3,043	0.17	1	0.18	0	0.17	0	0.26	0	0.19
Industrial	26,246	1.43	9	2.16	2	2.10	0	3.51	0	2.39
Residential	574,038	31.33	201	45.85	53	59.02	2	39.62	0	23.90
Religion	10,348	0.56	3	0.71	1	0.80	0	1.54	0	1.56
Single Family	1,121,593	61.21	187	42.73	26	29.46	2	39.60	0	60.03
Total	**1,832,359**		**439**		**90**		**5**		**0**	

Source: Hazus-MH

TABLE 4.K.4—500-YEAR EQ EXPECTED DAMAGE BY BUILDING OCCUPANCY

	None		Slight		Moderate		Extensive		Complete	
	Count	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agriculture	5,567	0.34	436	0.35	185	0.39	34	0.49	3	0.62
Commercial	77,860	4.71	6,032	4.84	3,210	6.79	655	9.47	77	14.22
Education	2,651	0.16	197	0.16	105	0.22	20	0.28	3	0.47
Government	2,732	0.17	192	0.15	101	0.21	17	0.25	2	0.39
Industrial	23,449	1.42	1,645	1.32	954	2.02	188	2.72	23	4.16
Residential	498,329	30.14	47,067	37.74	24,915	52.74	3,778	54.62	205	37.66
Religion	9,295	0.56	675	0.54	311	0.66	63	0.91	7	1.37
Single Family	1,033,488	62.50	68,477	54.90	17,458	39.96	2,162	31.25	224	41.12
Total	**1,653,371**		**124,721**		**47,239**		**6,917**		**544**	

Source: Hazus-MH

TABLE 4.K.5—100-YEAR EQ ESTIMATED BUILDING LOSSES (IN THOUSANDS OF DOLLARS)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Other	Total
Direct Building Loss	Structural	$230	$150	$170	$40	$40	$630
	Non-Structural	$670	$420	$330	$60	$70	$1,550
	Content	$70	$20	$60	$30	$10	$190
	Inventory	$0	$0	$0	$10	$0	$10
	Subtotal	$980	$600	$560	$130	$120	$2,390
Income Loss	Wage	$0	$10	$210	$10	$20	$250
	Capital-Related	$0	$10	$170	$0	$0	$180
	Rental	$40	$90	$150	$0	$10	$290
	Relocation	$140	$100	$170	$20	$40	$470
	Subtotal	$180	$200	$700	$30	$70	$1,180
	Total	$1,160	$800	$1,270	$160	$190	$3,580

Source: Hazus-MH

TABLE 4.K.6—500-YEAR EQ ESTIMATED BUILDING LOSSES (in thousands of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Other	Total
Direct Building Loss	Structural	$138,810	$71,730	$81,500	$19,000	$20,180	$331,220
	Non-Structural	$648,090	$308,250	$273,500	$80,060	$70,500	$1,380,400
	Content	$241,940	$75,570	$155,040	$55,930	$41,350	$569,830
	Inventory	$0	$0	$5,780	$15,950	$860	$22,590
	Subtotal	$1,028,840	$455,550	$515,820	$170,940	$132,890	$2,304,040
Income Loss	Wage	$0	$12,910	$113,880	$4,750	$8,970	$141
	Capital-Related	$0	$5,480	$94,350	$2,910	$1,980	$105
	Rental	$28,510	$42,700	$62,750	$1,990	$3,670	$140
	Relocation	$104,380	$54,680	$95,190	$10,390	$27,860	$293
	Subtotal	$132,890	$115,770	$366,170	$20,040	$42,480	$677
	Total	$1,161,730	$571,320	$881,990	$190,980	$175,370	$2,304,717

Source: Hazus-MH

TABLE 4.K.7—100-YEAR EQ EXPECTED DAMAGE TO ESSENTIAL FACILITIES

Classification	Total	At Least Moderate Damage >50%	Complete Damage >50%	With Functionality >50% on Day 1
Hospitals	108	0	0	108
Schools	1,550	0	0	1,550
EOCs	47	0	0	47
Police Stations	205	0	0	205
Fire Stations	482	0	0	482

Source: Hazus-MH

TABLE 4.K.8—500-YEAR EQ EXPECTED DAMAGE TO ESSENTIAL FACILITIES

Classification	Total	At Least Moderate Damage >50%	Complete Damage >50%	With Functionality >50% on Day 1
Hospitals	108	0	0	94
Schools	1,550	0	0	1,363
EOCs	47	0	0	44
Police Stations	205	0	0	192
Fire Stations	482	0	0	442

Source: Hazus-MH

TABLE 4.K.9—100-YEAR EQ EXPECTED DAMAGE TO TRANSPORTATION SYSTEMS

System	Component	Number of Locations				
		Locations/ Segments	At Least Moderate Damage	Complete Damage	With Functionality >50%	
					After Day 1	After Day 7
Highway	Segments	3,093	0	0	3,093	3,093
	Bridges	9,957	0	0	9,957	9,957
	Tunnels	0	0	0	0	0
Railways	Segments	1,922	0	0	1,922	1,922
	Bridges	23	0	0	23	23
	Tunnels	0	0	0	0	0
	Facilities	40	0	0	40	40
Bus	Facilities	44	0	0	44	44
Ferry	Facilities	14	0	0	14	14
Port	Facilities	88	0	0	88	88
Airport	Facilities	58	0	0	58	58
	Runways	78	0	0	78	78

Source: Hazus-MH

TABLE 4.K.10—500-YEAR EQ EXPECTED DAMAGE TO TRANSPORTATION SYSTEMS

System	Component	Number of Locations				
		Locations/ Segments	At Least Moderate Damage	Complete Damage	With Functionality >50%	
					After Day 1	After Day 7
Highway	Segments	3,093	0	0	3,093	3,093
	Bridges	9,957	0	0	9,957	9,957
	Tunnels	0	0	0	0	0
Railways	Segments	1,922	0	0	1,922	1,922
	Bridges	23	0	0	23	23
	Tunnels	0	0	0	0	0
	Facilities	40	0	0	40	40
Bus	Facilities	44	0	0	44	44
Ferry	Facilities	14	0	0	14	14
Port	Facilities	88	0	0	88	88
Airport	Facilities	58	0	0	58	58
	Runways	78	0	0	78	78

Source: Hazus-MH

TABLE 4.K.11—100-YEAR EQ EXPECTED TRANSPORTATION LOSSES (in thousands of dollars)

System	Component	Economic Losses ($)			
		Locations/Segments	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3,093	$61,050,570	$0	0
	Bridges	9,957	$8,425,300	$0	0
	Tunnels	0	$0	$0	0
	Subtotal	13,050	$69,475,870	0	0
Railways	Segments	1,922	$4,044,960	$0	0
	Bridges	23	$109,400	$0	0
	Tunnels	0	$0	$0	0
	Facilities	40	$106,520	$60	0.06
	Subtotal	1,985	$4,260,880	$60	0.06
Bus	Facilities	44	$39,330	$10	0.03
	Subtotal	44	$39,330	$10	0
Ferry	Facilities	14	$18,630	$0	0
	Subtotal	14	$18,630	$0	0
Port	Facilities	88	$175,740	$180	0.1
	Subtotal	88	$175,740	$180	0.1
Airport	Facilities	58	$617,760	$230	0.04
	Runways	78	$2,961,190	$0	0
	Subtotal	136	$3,578,950	$230	0.04
	Total	**15,317**	**$77,549,400**	**$480**	**0.23**

Source: Hazus-MH

TABLE 4.K.12—500-YEAR EQ EXPECTED TRANSPORTATION LOSSES (in thousands of dollars)

System	Component	Economic Losses ($)			
		Locations/Segments	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3,093	$61,050,570	$0	0.00
	Bridges	9,957	$8,425,300	$17,550	0.21
	Tunnels	0	$0	$0	0.00
	Subtotal	13,050	$69,475,870	$17,550	0.21
Railways	Segments	1,922	$4,044,960	$0	0.00
	Bridges	23	$109,400	$0	0.00
	Tunnels	0	$0	$0	0.00
	Facilities	40	$106,520	$8,230	7.73
	Subtotal	1,985	$4,260,880	$8,230	7.73
Bus	Facilities	44	$39,330	$1,840	4.68
	Subtotal	44	$39,330	$1,840	4.68
Ferry	Facilities	14	$18,630	$0	0.00
	Subtotal	14	$18,630	$0	0.00
Port	Facilities	88	$175,740	$30,050	17.10
	Subtotal	88	$175,740	$30,050	17.10
Airport	Facilities	58	$617,760	$35,740	5.79
	Runways	78	$2,961,190	$0	0.00
	Subtotal	136	$3,578,950	$35,740	5.79
	Total	**15,273**	**$77,510,070**	**$91,570**	**30.83**

Source: Hazus-MH

TABLE 4.K.13—100-YEAR EQ EXPECTED DAMAGE TO UTILITY SYSTEM PIPELINE

System	Number of Locations				
	Total	At Least Moderate Damage	Complete Damage	With Functionality >50%	
				After Day 1	After Day 7
Potable Water	1,798	0	0	1,798	1,798
Waste Water	2,577	0	0	2,577	2,577
Natural Gas	1	0	0	1	1
Oil Systems	35	0	0	35	35
Electrical Power	433	0	0	324	324
Communication	202	0	0	202	202

Source: Hazus-MH

TABLE 4.K.14—500-YEAR EQ EXPECTED DAMAGE TO UTILITY SYSTEM PIPELINES

System	Number of Locations				
	Total	At Least Moderate Damage	Complete Damage	With Functionality >50%	
				After Day 1	After Day 7
Potable Water	1,798	0	0	1,798	1,798
Waste Water	2,577	0	0	2,577	2,577
Natural Gas	1	0	0	1	1
Oil Systems	35	0	0	35	35
Electrical Power	433	0	0	324	324
Communication	202	0	0	202	202

Source: Hazus-MH

TABLE 4.K.15—100-YEAR EQ EXPECTED CASUALTIES

Time	Setting	Level 1	Level 2	Level 3	Level 4
2:00 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Reisdential	1	0	0	0
	Single-Family	1	0	0	0
	Total	**2**	**0**	**0**	**0**
2:00 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Reisdential	0	0	0	0
	Single-Family	0	0	0	0
	Total	**1**	**0**	**0**	**0**
5:00 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Reisdential	0	0	0	0
	Single-Family	0	0	0	0
	Total	**1**	**0**	**0**	**0**

Source: Hazus-MH

TABLE 4.K.16—500-YEAR EQ EXPEDTED CASUALTIES

Time	Setting	Level 1	Level 2	Level 3	Level 4
2:00 AM	Commercial	6	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	7	1	0	0
	Industrial	7	1	0	0
	Other-Reisdential	328	43	3	6
	Single-Family	356	45	4	7
	Total	**704**	**91**	**7**	**13**
2:00 PM	Commercial	371	61	6	12
	Commuting	0	0	1	0
	Educational	119	20	2	4
	Hotels	1	0	0	0
	Industrial	51	8	1	2
	Other-Reisdential	62	8	1	1
	Single-Family	69	9	1	1
	Total	**673**	**106**	**12**	**20**
5:00 PM	Commercial	297	50	5	10
	Commuting	7	8	15	3
	Educational	15	3	0	1
	Hotels	2	0	0	0
	Industrial	32	5	1	1
	Other-Reisdential	122	17	1	2
	Single-Family	138	18	2	3
	Total	**613**	**101**	**24**	**20**

Source: Hazus-MH

TABLE 4.K.17—EARTH QUAKE HISTORICAL EVENTS AND LOSSES

County	HISTORICAL EVENTS		
	Future Probability (% chance per year)	Annualized Losses	No. of Events
CHARLESTON	168.69	$14,279,067	528
BERKELEY	16.29	$5,741,057	51
DORCHESTER	51.76	$3,764,430	162
RICHLAND	6.71	$2,641,046	21
HORRY	0.00	$2,006,053	0
FLORENCE	0.32	$1,901,107	1
LEXINGTON	2.24	$1,417,822	7
GREENVILLE	1.92	$1,248,203	6
BEAUFORT	0.32	$1,206,997	1
ORANGEBURG	7.03	$1,122,114	22
SUMTER	0.32	$1,096,376	1
GEORGETOWN	0.64	$1,023,191	2
SPARTANBURG	1.92	$790,733	6
WILLIAMSBURG	0.00	$764,921	0
COLLETON	0.64	$611,500	2
AIKEN	1.60	$572,425	5
CLARENDON	0.32	$570,116	1
YORK	0.32	$488,181	1
ANDERSON	0.00	$475,356	0
DARLINGTON	0.00	$451,316	0
PICKENS	1.92	$304,678	6
KERSHAW	1.60	$299,154	5
MARION	0.00	$247,971	0
GREENWOOD	0.96	$241,164	3
LANCASTER	0.00	$213,019	0
LAURENS	1.60	$192,946	5
OCONEE	3.51	$177,681	11
CHESTERFIELD	1.28	$167,307	4
NEWBERRY	6.39	$148,452	20
DILLON	0.00	$140,924	0
BAMBERG	0.96	$125,001	3
BARNWELL	4.47	$123,567	14
HAMPTON	0.00	$123,511	0
CHEROKEE	0.00	$120,032	0
LEE	0.32	$113,588	1
JASPER	0.00	$112,910	0
CALHOUN	0.64	$109,871	2
MARLBORO	0.64	$104,168	2
CHESTER	2.24	$102,811	7
FAIRFIELD	177.96	$93,482	557
UNION	1.60	$82,474	5
EDGEFIELD	0.96	$79,006	3
ABBEVILLE	4.47	$69,236	14
SALUDA	0.64	$65,322	2
ALLENDALE	0.64	$49,303	2
MCCORMICK	2.56	$25,352	8
Grand Total	**476.36**	**$45,804,938**	**1,491**

L. SINKHOLES

Sinkholes are a natural geologic feature, common in areas with underlying limestone, carbonate rock, salt beds and other rock types that are soluble in water[82]. As the weathering and dissolving of rock materials occur, spaces and voids are created underground. When the spaces get too big, the collapse of the land surface above can occur, regardless of whether there is development above the cavern or not. While South Carolina does experience sinkholes, the majority of them are due to man-made activity (such as water line maintenance and drainage work). This plan does not analyze sink holes at this time because no loss data is collected.

Formation

Sinkholes form on karst terrain, which is a region of bedrock that can be dissolved by water[83]. Water that is slightly acidic dissolves bedrock to form channels in the rock called conduits. When rain moves through the soil, it erodes and dissolves the karst bedrock. This action creates cracks that are part of the conduit system and moves soil particles through it. When soil is carried off, the soil surface above the conduit may form a small depression that acts as a funnel to gather more water, and repeats the soil movement cycle in the crevices and conduits. Clay soils can act to plug up the conduit and form ponds.

While sinkholes can occur suddenly and expectantly, there are signs that can signal a potential development. Additionally, sinkhole formation may be aggravated by development and urbanization from increased water usage, altered drainage pathways and land surfaces. The signs of potential sinkhole formation include:

1. Slumping or falling fence posts, trees, or foundations;
2. Sudden formation of small ponds;
3. Wilting vegetation;
4. Discolored well water; and/or
5. Structural cracks in walls, floors.

Classification

There are three types of sinkholes: subsidence, dissolution, and collapse. Subsidence sinkholes develop gradually where the cover layer is permeable, and mostly made of sand. Dissolution sinkholes have a thin overburden of limestone or dolomite. Exposed carbonate bedrock allows for intensive dissolution because of the thin overburden. Collapse sinkholes are the quickest to develop and may cause the greatest damages. This is where the cover layer contains a lot of clay sediment, and over time the sinkhole develops a shallow bowl-shaped depression (ga.water.usgs.gov). Additionally, sinkholes have been related to human activities, primarily from groundwater extraction and development. Sinkholes can develop where the natural water-drainage system and land surface is changed and runoff- storage ponds are formed. Weight of new material can trigger a collapse of the soil surface, causing a sinkhole.

M. LANDSLIDES AND MASS WASTING

According to United States Geological Survey Landslide Hazards Program, landslides are geologic hazards that occur in all states, and cause $1-2 billion dollars in damage, and over 25 average annual fatalities[84]. Mass wasting is the downward movement of rock material. Landslides are a type of mass wasting, which refers to the sudden collapse of a slope, or also known as a slope failure[85]. Other types of mass wasting include mudflow, earthflow, creep, rock fall, slump, and these are characterized by their speed of downward movement and the amount of moisture.

Upstate South Carolina most closely fits the typical landslide topography as outlined by the U.S. Geological Survey (USGS), with steep slopes on Table Rock, Caesars Head and Glassy Mountain as areas having rock slides. In the Piedmont, minor landslides are more prevalent due to slope failure of saprolite and soil, leading to gully formation. These are primarily triggered by rain events and erosion. In the state's Coastal Plain, riverbanks are susceptible to slope failure on a larger scale, causing erosion. While South Carolina is susceptible to landslides, no major events have occurred in the past; therefore this plan does not analyze landslides at this time because no loss data is collected.

Figure 4.M.1 shows landslide susceptibility and incidence throughout the state according to the USGS while **Figure 4.M.2** depicts the same landslide information but with state building locations.

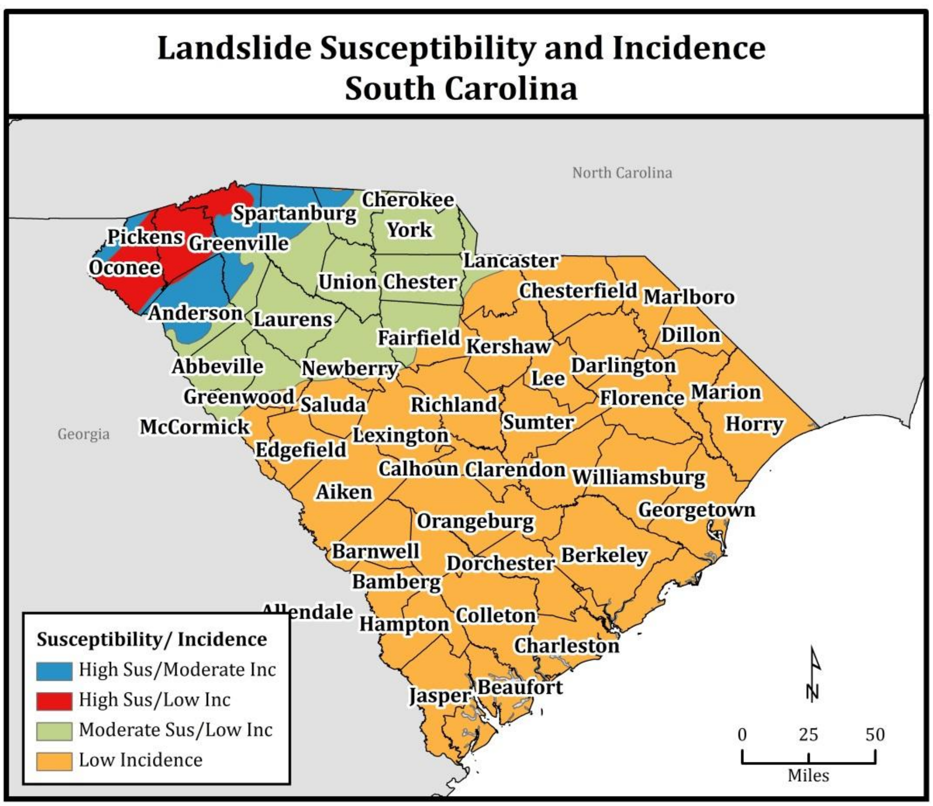


FIGURE 4.M.1—LANDSLIDE SUSCEPTIBILITY AND INCIDENCE

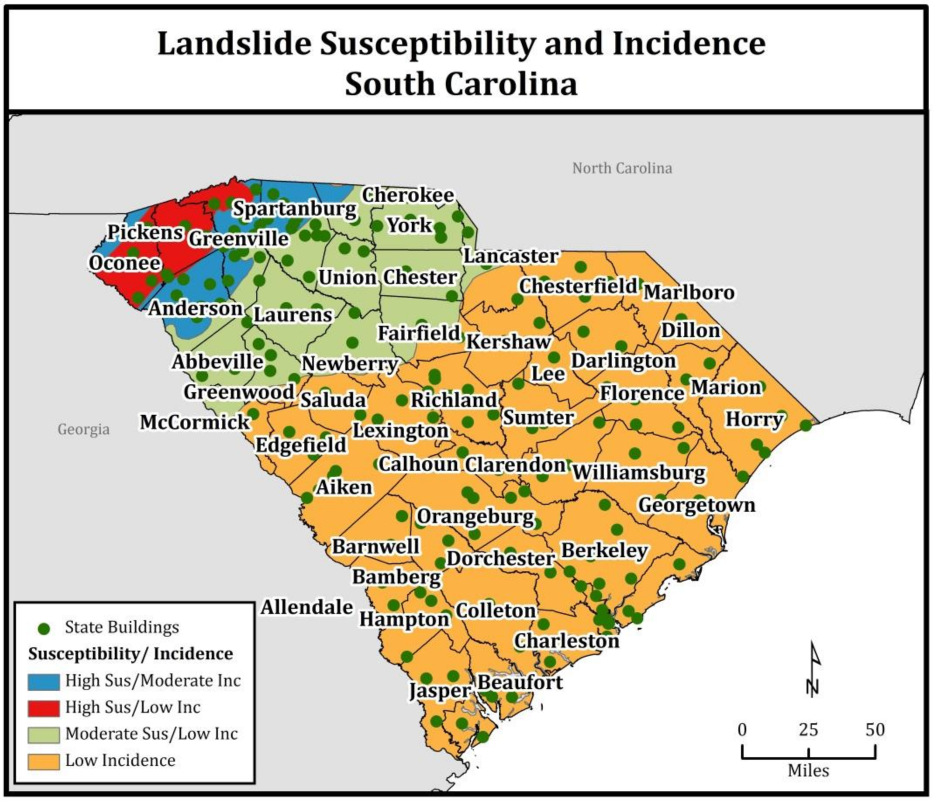


FIGURE 4.M.2—LANDSLIDE SUSCEPTIBILITY AND INCIDENCE WITH STATE BUILDINGS

Formation

Slope movement occurs naturally due to gravity, when the strength of the earth materials exceed the angle of repose, the angle at which earth materials can rest on a slope without downward movement. Landslides have multiple causes, but many are triggered by rain, or some change in moisture level. Earthquakes, volcanic, and human activity may also trigger landslides. Landslides that occur underwater from earthquakes are called submarine landslides and can cause tsunamis.

Classification

Landslides occur abruptly and rapidly, carrying large masses of rock and soil. This speed distinguishes landslides from other slower mass-wastings, which can be slower and more gradual. Measuring the speed of landslides is difficult, but reports have been given at speeds of up to 100 miles an hour.

A more common form of mass wasting is called flow, occurs when a section of the slop becomes unstable and flows downhill. The movement can be quick, or it may be gradual. Flows are relatively small, and are a shallow phenomenon that includes the movement of soil and loose rocks. The most common form of mass wasting is an earthflow, which involves a portion of a water-saturated slope that moves a limited distance, generally after a rainfall. There the flow originates is a scare in the surface of the slow. This mass wasting often results in the forced closures of roads and rails.

N. HAZARDOUS MATERIALS

In many places, people and communities are surrounded by chemicals and hazardous materials (HAZMAT). These materials, in its various forms, can cause death, injury, long term health problems, and damage to property[86]. Hazardous materials come in many forms and incidents can apply to fixed or mobile facilities. Hazardous materials are stored in homes and businesses and shipped daily on highways, railroads, waterways, and pipelines. Facilities that store or use hazardous materials are scattered throughout the state, but many are located in coastal counties, where they are also exposed to hurricane winds and rains. South Carolina's industrial capacity and network of highways and railways result in vulnerabilities to hazardous material releases[87].

Hazardous material incidents can include the spilling, leaking, pumping, emitting, discharging, escaping, leaching, or disposing into the environment of a hazardous material, but exclude: (1) any release which results in exposure to poisons solely within the workplace with respect to claims which such persons may assert against the employer; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel or pipeline pumping station engine; (3) release of source, byproduct, or special nuclear material from a nuclear incident; and (4) the normal application of fertilizer.

Location

Figure 4.N.1 below shows the locations of Superfund sites, Toxic Release Inventory (TRI) facilities, and other hazardous material sites for South Carolina, for the year 2011. According to the EPA, Superfund sites are uncontrolled or abandoned places where hazardous waste is located that may potentially affect the local ecosystem or community. The TRI database contains information on 650 chemicals and chemical categories that industrial and other facilities manage (dispose of, recycle, treatment of, etc) for the country[88]. **Table 4.N.1** lists by county the total number of TRI facilities, Superfund sites, treatment, storage, and disposal sites, and landfills. Greenville County has the most TRI and Superfund sites, with a total of 148 sites.

Historical and Notable Events

January 6, 2005[89]: In the early morning of the 6th, a northbound freight train traveling through Graniteville in Aiken County was improperly diverted and collided with a parked train, causing the derailment of both locomotives and 16 of the 42 freight cars on the northbound train. Of the derailed, 3 of them were tank cars containing chlorine gas, one of which was breached. Nine people died from chlorine inhalation and over 500 were taken to hospitals for respiratory difficulties. About 5,400 people were evacuated within a one-mile radius of the derailment site. This incident caused damages of over $6.9 million dollars.

Table 4.N.2 gives the summary of historical and recent losses and events from 1990 to the present. Information on this table comes from the Spills and Accidents Database.

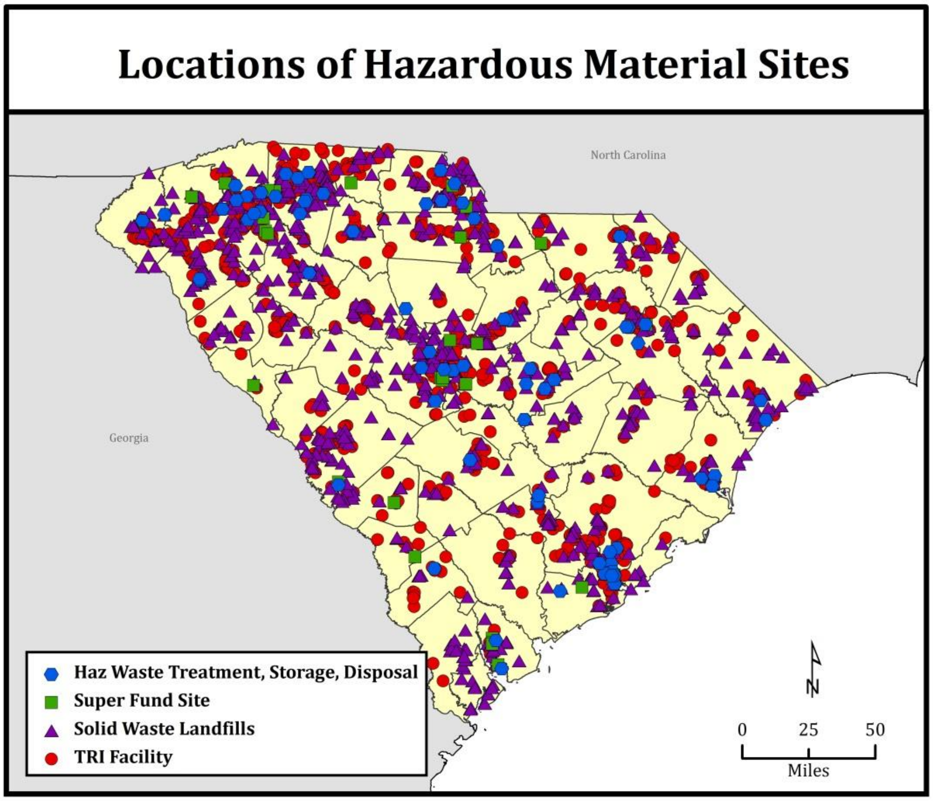


FIGURE 4.N.1—LOCATIONS OF HAZMATs, 2011
Source: SC DHEC

TABLE 4.N.1—HAZARDOUS MATERIALS SITES BY COUNTY

County	TRI	Superfund	Haz Treatement, Storage, Disposal	Solid Waste Landfills	Total
Abbeville	11	0	0	17	28
Aiken	35	1	1	60	97
Allendale	5	1	0	7	13
Anderson	42	0	2	51	95
Bamberg	6	0	0	6	12
Barnwell	10	1	0	6	17
Beaufort	5	4	2	32	43
Berkeley	37	0	2	21	60
Calhoun	6	0	0	6	12
Charleston	58	3	9	50	120
Cherokee	27	1	0	17	45
Chester	26	1	0	19	46
Chesterfield	22	1	1	9	33
Clarendon	3	0	0	15	18
Colleton	13	0	0	11	24
Darlington	17	0	0	20	37
Dillon	4	0	0	13	17
Dorchester	29	0	1	28	58
Edgefield	5	0	0	8	13
Fairfield	5	0	1	8	14
Florence	29	1	4	22	56
Georgetown	14	0	3	23	40
Greenville	144	4	7	59	214
Greenwood	22	0	0	16	38
Hampton	12	0	1	7	20
Horry	17	0	2	31	50
Jasper	2	0	0	21	23
Kershaw	15	0	2	26	43
Lancaster	20	0	2	32	54
Laurens	22	0	1	33	56
Lee	3	0	0	7	10
Lexington	46	3	4	58	111
Marion	6	0	0	13	19
Marlboro	14	0	0	16	30
McCormick	2	1	0	4	7
Newberry	17	0	0	20	37
Oconee	24	0	2	23	49
Orangeburg	28	0	2	21	51
Pickens	22	1	1	28	52
Richland	56	3	2	57	118
Saluda	2	0	0	5	7
Spartanburg	118	2	8	77	205
Sumter	27	0	5	22	54
Union	9	0	1	16	26
Williamsburg	9	0	0	20	29
York	47	2	5	47	101
TOTAL	**1093**	**30**	**71**	**1108**	**2302**

TABLE 4.N.2—HISTORICAL AND RECENT MOBILE AND FIXED HAZMAT EVENTS AND LOSSES

County	HISTORICAL EVENTS (1990-2011)								RECENT EVENTS (2009-2011)				
	Future Probability (% chance per year)	Frequency Interval	Annualized Losses	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Deaths	Injuries	No. of Events	No. of Loss-Causing Events	Recorded Property Damage	Deaths	Injuries
LANCASTER	63.64	1.57	$3,636	14	1	$80,000	0	1	0	0	$0	0	0
RICHLAND	527.27	0.19	$3,636	116	5	$80,000	0	9	14	0	$0	0	0
GREENVILLE	713.64	0.14	$2,818	157	15	$62,000	1	30	17	0	$0	0	0
LEE	4.55	22.00	$2,727	1	0	$60,000	0	0	0	0	$0	0	0
CHEROKEE	190.91	0.52	$2,273	42	5	$50,000	0	4	5	1	$0	0	0
CHARLESTON	1918.18	0.05	$227	422	11	$5,000	0	19	37	3	$0	0	3
YORK	859.09	0.12	$168	189	3	$3,700	0	3	2	1	$3,700	0	0
HORRY	318.18	0.31	$91	70	3	$2,000	0	15	7	1	$2,000	0	0
ABBEVILLE	27.27	3.67	$0	6	0	$0	0	0	0	0	$0	0	0
AIKEN	331.82	0.30	$0	73	6	$0	0	5	6	2	$0	0	2
ALLENDALE	31.82	3.14	$0	7	0	$0	0	0	1	0	$0	0	0
ANDERSON	254.55	0.39	$0	56	5	$0	2	7	5	0	$0	0	0
BAMBERG	31.82	3.14	$0	7	0	$0	0	0	1	0	$0	0	0
BARNWELL	118.18	0.85	$0	26	2	$0	0	4	0	0	$0	0	0
BEAUFORT	390.91	0.26	$0	86	2	$0	3	24	7	0	$0	0	0
BERKELEY	768.18	0.13	$0	169	6	$0	1	5	19	2	$0	0	2
CALHOUN	313.64	0.32	$0	69	0	$0	0	0	12	0	$0	0	0
CHESTER	172.73	0.58	$0	38	2	$0	1	3	1	0	$0	0	0
CHESTERFIELD	86.36	1.16	$0	19	2	$0	1	1	2	0	$0	0	0
CLARENDON	27.27	3.67	$0	6	0	$0	0	0	1	0	$0	0	0
COLLETON	68.18	1.47	$0	15	1	$0	0	4	2	0	$0	0	0
DARLINGTON	200.00	0.50	$0	44	4	$0	3	1	3	1	$0	0	1
DILLON	72.73	1.38	$0	16	1	$0	0	2	2	1	$0	0	2
DORCHESTER	222.73	0.45	$0	49	3	$0	0	3	1	0	$0	0	0
EDGEFIELD	45.45	2.20	$0	10	0	$0	0	0	2	0	$0	0	0
FAIRFIELD	145.45	0.69	$0	32	0	$0	0	0	1	0	$0	0	0
FLORENCE	336.36	0.30	$0	74	7	$0	2	7	4	1	$0	1	0
GEORGETOWN	395.45	0.25	$0	87	1	$0	0	1	8	0	$0	0	0
GREENWOOD	200.00	0.50	$0	44	1	$0	0	1	1	0	$0	0	0
HAMPTON	40.91	2.44	$0	9	0	$0	0	0	3	0	$0	0	0
JASPER	31.82	3.14	$0	7	0	$0	0	0	1	0	$0	0	0
KERSHAW	363.64	0.28	$0	80	4	$0	0	8	7	0	$0	0	0
LAURENS	113.64	0.88	$0	25	1	$0	0	1	4	0	$0	0	0
LEXINGTON	777.27	0.13	$0	171	3	$0	1	2	9	0	$0	0	0
MARION	13.64	7.33	$0	3	1	$0	0	1	0	0	$0	0	0
MARLBORO	118.18	0.85	$0	26	2	$0	0	4	3	0	$0	0	0
MCCORMICK	36.36	2.75	$0	8	0	$0	0	0	0	0	$0	0	0
NEWBERRY	36.36	2.75	$0	8	0	$0	0	0	0	0	$0	0	0
OCONEE	209.09	0.48	$0	46	4	$0	0	4	5	1	$0	0	1
ORANGEBURG	1004.55	0.10	$0	221	6	$0	2	9	5	0	$0	0	0
PICKENS	204.55	0.49	$0	45	1	$0	0	1	2	0	$0	0	0
SALUDA	36.36	2.75	$0	8	0	$0	0	0	1	0	$0	0	0
SPARTANBURG	895.45	0.11	$0	197	6	$0	0	10	14	1	$0	0	1
SUMTER	450.00	0.22	$0	99	3	$0	0	3	16	0	$0	0	0
UNION	63.64	1.57	$0	14	0	$0	0	0	2	0	$0	0	0
WILLIAMSBURG	68.18	1.47	$0	15	0	$0	0	0	2	0	$0	0	0
Grand Total	**13,300.00**	**77.98**	**$15,577**	**2,926**	**117**	**$342,700**	**17**	**192**	**235**	**15**	**$5,700**	**1**	**12**

O. PUBLIC HEALTH HAZARDS/INFECTIOUS DISEASE

The South Carolina Department of Health and Environmental Control (DHEC) conducted a *Hazard Vulnerability Analysis* in 2005 and then performed an additional analysis, the *Vulnerable Populations and Health Hazard Risk Assessment Data,* in 2012. These assessments, which focus on the public health impact of the hazard, profiled and ranked the fifteen hazards listed below. The hazards are listed in order of priority rank based on the potential impact on human health as determined by the Public Health Hazard Vulnerability Assessment Working Group. Some of these hazard types are addressed below in the Terrorism section (S). Because the Public Health Working group determined that Pandemic Influenza was the greatest threat to human health, the State wanted to be sure it was referenced in the State Hazard Mitigation Plan.

1. Biological Disease Outbreak – Pandemic Influenza
2. Natural Disaster – Major Earthquake
3. Nuclear Detonation – 10-Kiloton Improvised Nuclear Device
4. Natural Disaster – Major Hurricane
5. Biological Attack – Pneumonic Plague
6. Chemical Attack – Blister Agent
7. Chemical Attack – Nerve Agent
8. Chemical Attack – Toxic Industrial Chemicals
9. Chemical Attack – Chlorine Tank Explosion
10. Biological Attack – Aerosol Anthrax
11. Radiological Attack – Radiological Dispersal Devices
12. Explosive Attack – Bombing Using Improvised Explosive Devices
13. Biological Attack – Food Contamination
14. Biological Attack – Foreign Animal Disease
15. Cyber Attack

The *Vulnerable Populations and Health Hazard Risk Assessment* analyzed demographic, health, and social vulnerability indicators to systematically study public health and vulnerability at a local and regional scale. Indicators included population, gender, race, and age data, as well as economic, disability, isolation, mortality, injury, healthcare, and literacy information. The data collected can be used to identify and address the needs of vulnerable populations in emergency plans.

Because comparable analytics and methodologies for public health hazards and natural hazards are not available at this time, no further analysis is included. In future plan updates, the State would like to pursue a more detailed statewide analysis.

P. NUCLEAR POWER PLANTS

South Carolina has 5 nuclear power sites in the state (**Figure 4.P.1**). Additionally, three nuclear power sites are located in neighboring states that could potentially affect South Carolina residents. Five counties serve as host counties for the facilities (Oconee, York, Fairfield, Aiken, and Darlington). All but five of the state's counties fall within the 10-mile or 50-mile emergency-planning zone of at least one nuclear facility. These five are Beaufort, Berkeley, Charleston, Dorchester, and Georgetown.

Nuclear power plant accidents are rare events. According to Duke Power, typical nuclear power plants have the following:

- About one chance in twenty thousand per year that a nuclear power plant will experience a serious accident, and
- About one chance in four million per year that anyone in the public would die as a direct result of a nuclear accident.

Although these statistics suggest that the chances of a serious accident are considered extremely low, annual updates of emergency operation plans for nuclear power plant incidents and regular training exercises are an absolute must to ensure the safety of the public and the environment.

There has been one incident involving radioactive material in South Carolina since 2001, which occurred in Barnwell County. The May 27th, 2004 incident, classified as a non-emergency event by the Nuclear Regulatory Commission, involved surface contamination levels greater than their prescribed limits. Contamination levels in excess of USDOT (U.S. Department of Transportation) and Barnwell County limits were found on a ship in a Sea Land container when it reached its destination. A condensation puddle inside the container leaked out onto the trailer bed; there were no personnel exposures.

GIS analysis was performed to get an estimate of total population (at the census tract level) within a 10-mile and 50-mile buffer of the nuclear power sites. Total population within the 10-mile buffer totals 289,076; within the 50-mile buffer, total population is 3,137,733. **Figure 4.P.1** is also provided to show where state-owned buildings are in relation to the buffers and the nuclear power sites. Given that there has only been one incident, further analysis of this hazard was not considered.

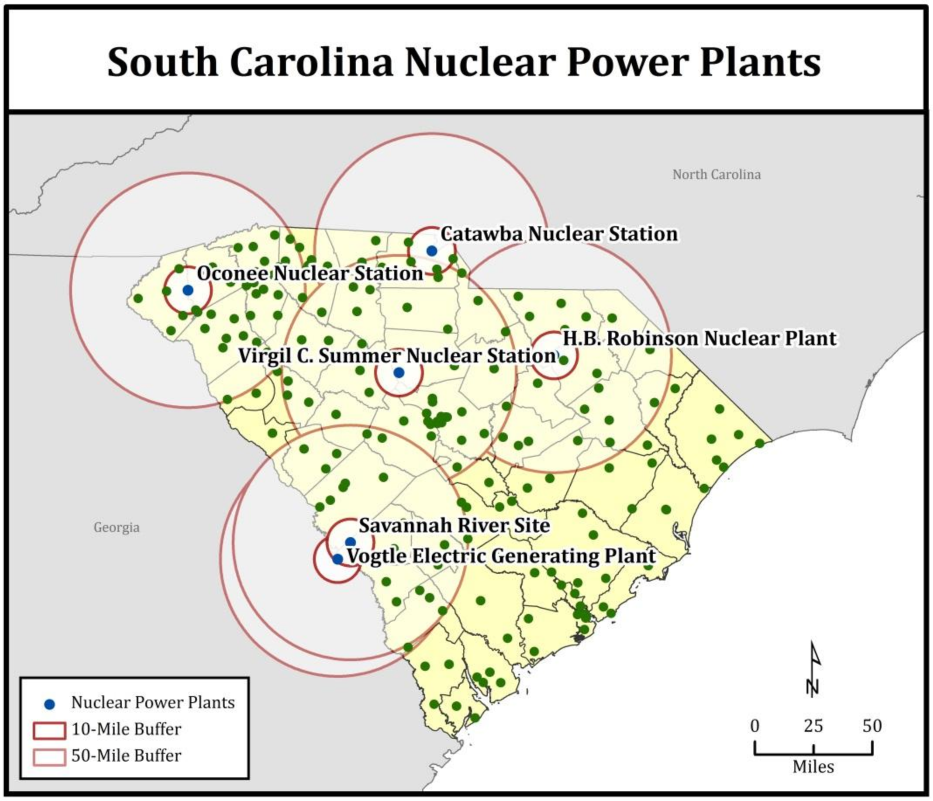


FIGURE 4.P.1—NUCLEAR POWER PLANTS WITH 10 & 50-MILE BUFFERS AND STATE BUILDINGS

Q. SEA LEVEL RISE

Coastal areas are sensitive to a variety of hazards, including storms, erosion, and gradual sea level rise (SLR)[90]. It is difficult to predict the amount of sea level rise along the coast of South Carolina, but there are numerous factors related to this hazard, including land subsidence, groundwater depletion, wave action, hurricanes, and natural climate variation[91]. The EPA suggests that sea level rise may increase the impact of coastal storms[92]. Modeling sea level rise is based on historical evidence[93]. The Intergovernmental Panel on Climate Change (IPCC) released a climate change and sea level rise report in 2007. For coastal regions in the United States, it is estimated that we will see at least 0.6m of sea level rise, and more likely up to 2.0m rise. SCEMD used these estimates to perform an analysis of 0.6m, 1.0m, and 2.0m sea level rise.

Method and Results

For this section of the report, the spatial identification of the potential inundation zones was accomplished with a typical "bathtub" flood modeling approach similar to those used in other studies[94]. Here LIDAR derived raster elevation data (DEMs) are classified as flooded by first identifying the DEM grid cells that have an elevation at or below a given sea-level rise scenario (0.6 m, 1m and 2m). This selection was further dissected to remove grid cells that met the elevation criteria but are not connected (geospatially) to the water source (in this case the Atlantic Ocean). A standard spatial cost distance algorithm[95] further culled cells based on connectivity where the "cost" to travel across a non-flooded grid cell would preclude non-adjacent cells from being counted as flooded.

Analysis for each county provides a general understanding of the impacts of potential sea-level rise. **Table 4.Q.1** shows the maximum and average inundation levels for each coastal county. Overall, Beaufort County has the most land area to lose in any of the modeled sea-level rise scenarios. However both Colleton and Georgetown Counties stand to lose substantial land area based on current projections. Coastal counties attract tourists because of the natural beauty of the beaches and other recreational activities. The continuation of coastal development, critical infrastructure, services, and physical property are located in potential threat zones. Horry and Charleston, two of the larger tourist destinations, stand to lose significantly less land area than other coastal counties, but these areas are not immune from the effects of sea-level rise. **Figures 4.Q.1 - 4.Q.3** display the sea level rise analysis results for the coastal area projected impact from 0.6 meter, 1 meter, and 2 meter sea level rise. In future updates to the SHMP, South Carolina will work to improve sea level rise analysis. The IPCC will release their next report and estimates of climate change in late 2013 or early 2014. South Carolina will consider the new estimates in future risk analysis.

TABLE 4.Q.1—PROJECTED INUNDCATION FROM MODELED SEA LEVEL RISE SCENARIOS

	0.6m. SLR Inundation Water Depths (feet)				1m. SLR Inundation Water Depths (feet)				2m. SLR Inundation Water Depths(feet)			
County	Maximum	Average	Total Land Area Inundated (Sq. Miles)	Land Area Inundated > 2 feet	Maximum	Average	Total Land Area Inundated	Land Area Inundated > 2 feet	Maximum	Average	Total Land Area Inundated	Land Area Inundated > 2 feet
Beaufort	7.5	0.7	117	7	8.9	1.1	191	35	12.1	3.4	265	200
Charleston	5.9	1	40	5	7.3	1.7	58	17	10.5	3.5	93	66
Colleton	5.8	1.1	37	5	7.1	1.1	104	11	10.4	3.3	172	129
Georgetown	1.6	0.2	62	0	6.7	1.2	147	25	9.93	3.3	207	159
Horry	2.2	0.2	0	0	8.3	1.3	38	4	11.5	3.6	59	47
Jasper	6.5	2	12	4	7.8	0.9	53	5	11.1	3.1	99	73

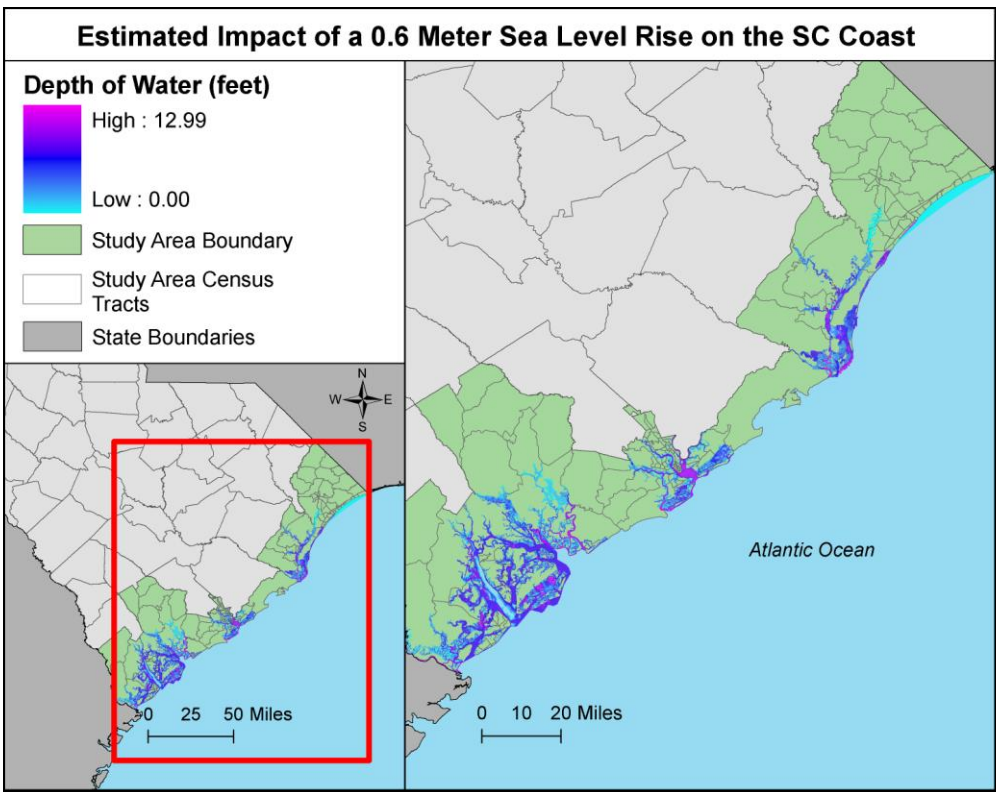


FIGURE 4.Q.1—IMPACT OF 0.6M SEA LEVEL RISE ON THE SOUTH CAROLINA COAST

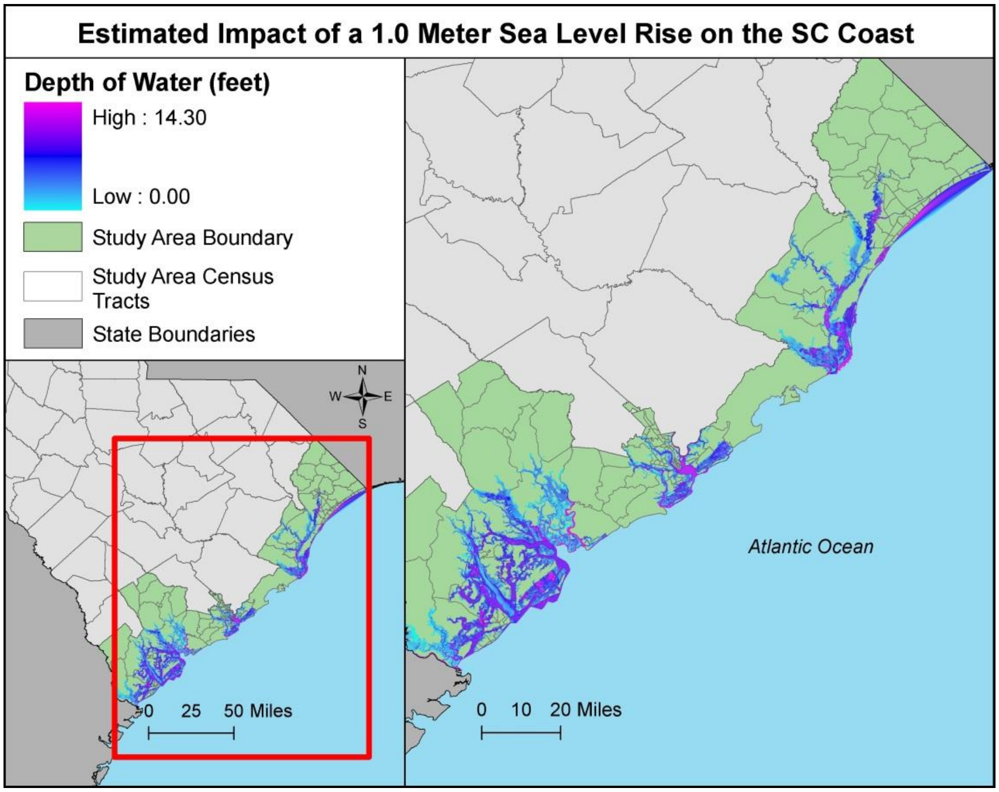


FIGURE 4.Q.2—IMPACT OF 1.0M SEA LEVEL RISE ON THE SOUTH CAROLINA COAST

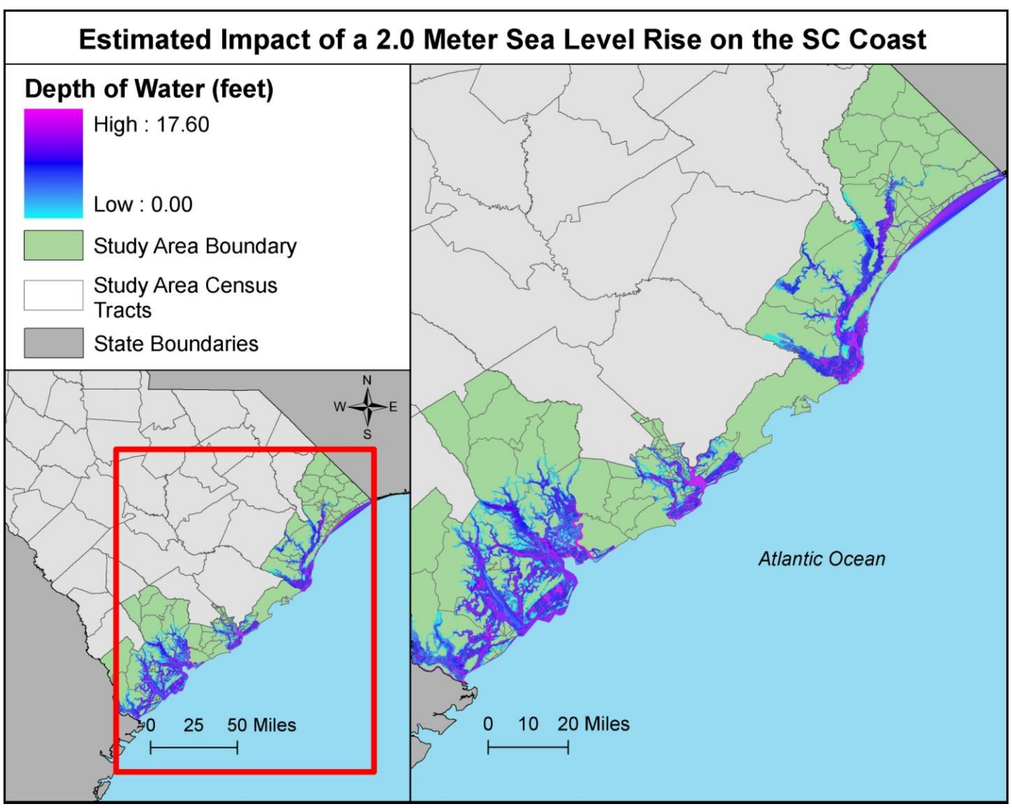


FIGURE 4.Q.3—IMPACT OF 2.0M SEA LEVEL RISE ON THE SOUTH CAROLINA COAST

R. TSUNAMI

The word tsunami is Japanese and means "harbor wave". A tsunami is a series of oceanic waves formed by earthquakes, landslides, volcanic eruptions, or the sudden displacement of the sea floor[96]. From where the tsunami waves originate, it moves outward in all directions[97]. At its origin in the deep ocean, the wave may be only a few inches, but as it approaches shore it builds in height and speed and can be several meters high[98]. The National Oceanic and Atmospheric Administration (NOAA) is the primary agency for providing tsunami warnings, with roles in research and observations as well.

Location

All tsunamis pose a threat to coastal communities and can occur anywhere along the U.S. coastline. Although tsunamis are associated with Pacific Rim states (Hawaii, California, Oregon, Washington, and Alaska), historical evidence does indicate that tsunamis have affected the Eastern United States. Tsunami events along the East Coast are not the result of traditional sources of tsunami waves (i.e., subduction zones such as the Cascadia Subduction Zone), but rather are typically the result of slumping or landsliding associated with local earthquakes or with wave action associated with strong storms such as hurricanes. Other possible causes of tsunami-like activity along the East Coast could include explosive decompression of underwater methane deposits, the impact of a heavenly body (i.e., an asteroid, comet or oceanic meteor splashdown), or a large underwater explosion. One significant contributing factor to tsunami-related damage is the massive amount of moving debris possible during a tsunami event—including manmade debris such as boats and on-shore debris as the tsunami strikes land.

Areas at greater risk are where it is located less than 25 feet above sea level and within a mile of the shoreline. Drowning is the primary cause of death from tsunamis. Tsunamis on the east coast are typically the result of underwater landslides. The most active earthquake faults in South Carolina are on land so they do not create tsunamis, but faults near the Caribbean and southern Spain are prone to thrust faulting, so South Carolinians need to be aware of the risk of tsunamis[99].

Two offshore areas are currently under investigation according to a 2002 National Geophysical Data Center report. One area of interest consists of large cracks northeast of Cape Hatteras that could signal the early stages of an underwater landslide that could result in a tsunami. The other area of interest consists of submarine canyons approximately 150 kilometers from Atlantic City, New Jersey. A significant factor for consideration with regard to these areas is recent discoveries along the East Coast that demonstrate the existence of pressurized hydrates and pressurized water layers in the continental shelf. This has produced speculation among the scientific community on possible triggers that could cause sudden and perhaps violent releases of compressed material that may cause landslides and tsunami waves.

The TsuanamiReady Program, developed by the National Weather Service assists with cities, towns, counties, universities, and other sites in coastal areas to reduce the risk of loss from tsunami-related consequences[100]. In South Carolina, there are seven TsuanmiReady sites, located in three counties, and four communities. Additional information on the program and a map of participating communities is included in Section 6.

Historical and Notable Events

The tsunami threat for South Carolina is extremely low, and any tsunamis would likely be small and inundate the beaches exclusively. Although the risk is low, the consequences could be high. Tsunamis have been recorded on the U.S. Atlantic Coast in 1755, 1884, 1886, and in 1929. In fact, 40 tsunamis and tsunami-like waves have been documented in the Eastern United States since 1600. The August 31, 1886, Charleston, SC, earthquake had an estimated magnitude of 7.3 with the epicenter estimated to be just onshore. In South Carolina, the maximum run-ups for this event measured in the range of 0.5 to 20 inches. No fatalities were attributed to this event, although any tsunami run-up over three feet is dangerous to people and property. Due to the extremely low probability and consequence of tsunamis, this plan will not further analyze this hazard.

S. TERRORISM

Information in this subsection borrows heavily from the FEMA State and Local Mitigation Planning How-to Guide: Integrating Manmade Hazards Into Hazard Mitigation Planning. For the sake of brevity and consistency with other subsections of this hazard identification, each individual element of terrorism is introduced in relatively abbreviated format. For additional information, refer to Jane's Chem-Bio Handbook and FEMA's Radiological Emergency Management Independent Study Course.

Armed Attack: This element of terrorism refers primarily to tactical assault or sniping from a remote location.

Arson/Incendiary Attack: Arson/incendiary attack refers to the initiation of fire or explosion on or near a target either by direct contact or remotely via projectile.

Agriterrorism: The direct, typically covert contamination of food supplies or the introduction of pests and/or disease agents to crops and livestock.

Biological Agent: Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point or line sources such as munitions, covert deposits and moving sprayers.

Chemical Agent: Liquid/aerosol contaminants can be dispersed using sprayers or other aerosol generators; liquids vaporizing from puddles or containers; or munitions.

Conventional Bomb/Improvised Explosive Device: This refers to the intentional detonation of an explosive device on or near a target with the mode of delivery being via person, vehicle or projectile.

Cyber-terrorism: Cyber-terrorism refers to electronic attack using one computer system against another.

Intentional Hazardous Material Release: Solid, liquid and/or gaseous contaminants may be intentionally released from either fixed or mobile containers.

The Department of Homeland Security (DHS) and the South Carolina Law Enforcement Division (SLED) handle all weapons of mass destruction (WMD) and terrorism related assessments, risk and vulnerability analyses, mitigation actions and funding. The 2012 South Carolina Threat and Hazard Identification and Risk Assessment (THIRA) was recently completed. Due to the nature of the assessment and official data used in the analysis, it cannot be included in this plan. The analysis examined natural and human-induced hazards, to include WMD and terrorism scenarios. For further information concerning WMD and terrorism hazard information for South Carolina, contact DHS/SLED.

T. ALL-HAZARD VULNERABILITY

The diverse landscape of South Carolina gives rise to a variety of hazard events, including coastal hazards, meteorological hazards, geophysical hazards, technological hazards, and others. A hazard's future annual probability of occurrence and the hazards' annualized losses were calculated to give an overall hazard score for each county (**Figure 4.T.1** and **Figure 4.T.2**). **Table 4.T.2** and **Figure 4.T.3** displays the total count of hazard events (using the entire period of record where available), for each county, **Table 4.T.2,** an annual probability of hazard events by county (the risk, or the percent chance per year of a single event occurring), and **Table 4.T.3**, and **Figure 4.T.4** displays hazard annualized losses for each county.

Williamsburg County has the highest count of hazard events (7,393) and Allendale County has the lowest count (827). Each county in South Carolina have over 100% chance of an event occurring in a year. This is not surprising since the number of hazards that can occur in the state is so diverse. Charleston County has the highest annualized losses from hazard events ($52,269,347) and McCormick County has the lowest annualized losses from hazards ($733,400).

Charleston County also has the highest Hazard Score, for both calculations based on future annual probability and annualized losses. McCormick County has the lowest overall Hazard Score for both calculations based on future annual probability and annualized losses. A comparison of risk scores can be found in **Table 4.T.4.**

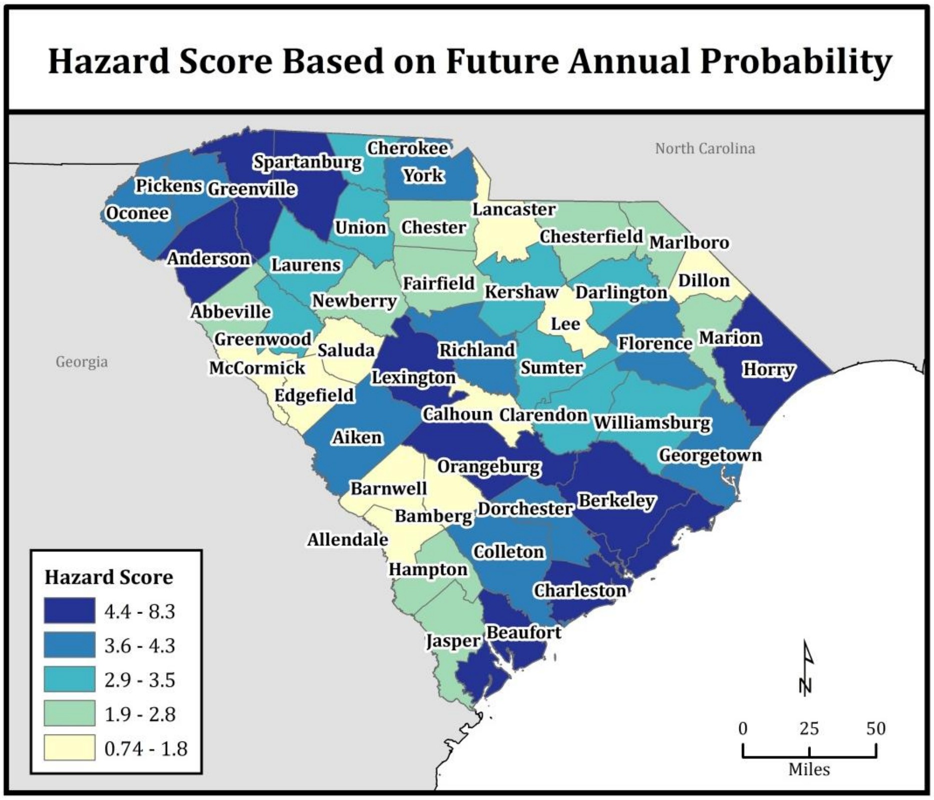


FIGURE 4.T.1—TOTAL HAZARD SCORE BASED ON FUTURE ANNUAL PROBABILITY OF EVENTS

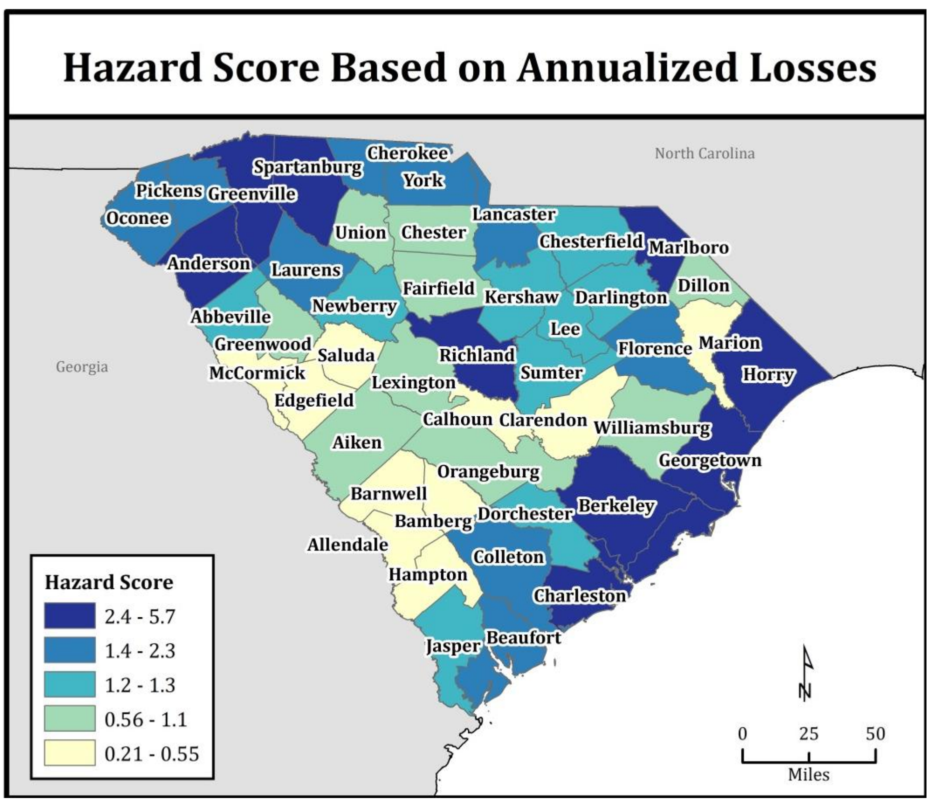


FIGURE 4.T.2—TOTAL HAZARD SCORE BASED ON HISTORICAL ANNUAL LOSSES OF EVENTS

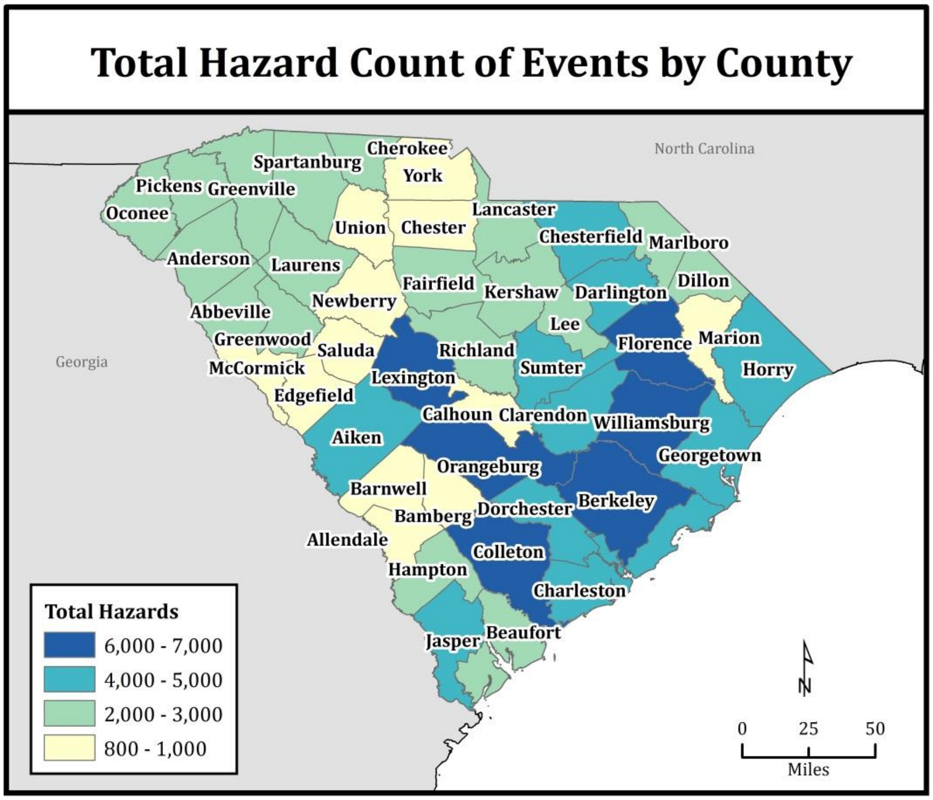


FIGURE 4.T.3—TOTAL HAZARD EVENTS

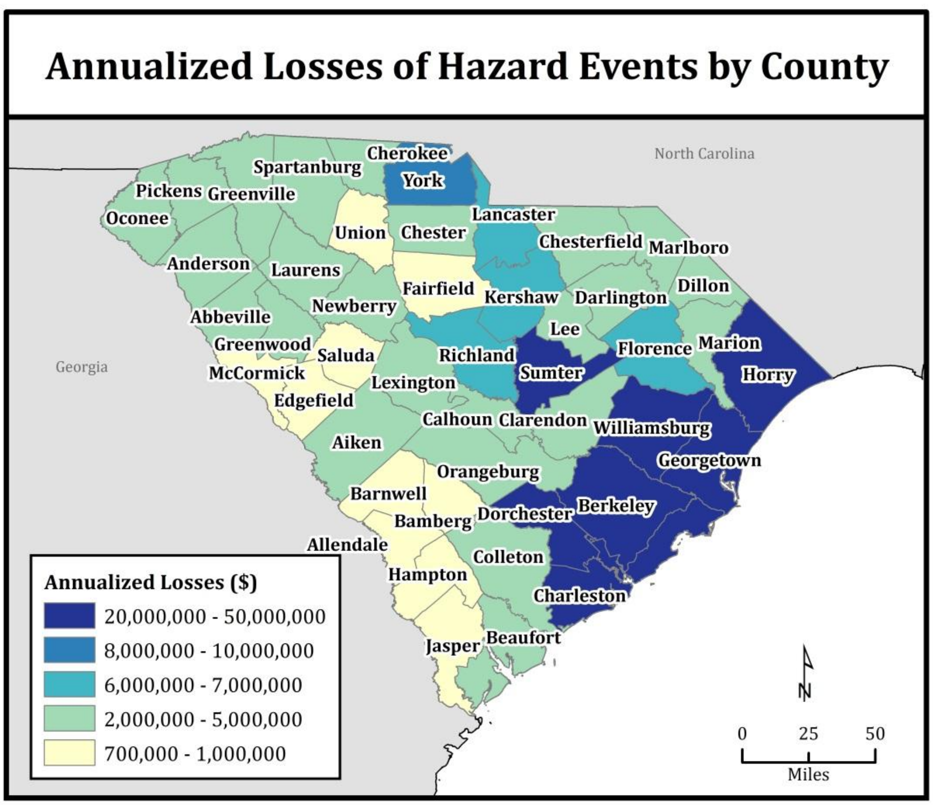


FIGURE 4.T.4—HISTORICAL ANNUALIZED LOSSES

TABLE 4.T.1—TOTAL HAZARD EVENTS

COUNT OF TOTAL HAZARDS BY COUNTY													
County	Total Hazards	Hurricane	Coastal	Severe Storm	Lightning	Tornado	Flood	Wildfire	Drought	Hail	Winter Storms	Earthquake	HAZMAT
ABBEVILLE	1,754	8	1	140	18	13	19	1,341	42	87	65	14	6
AIKEN	4,565	19	1	244	25	31	19	3,952	9	153	34	5	73
ALLENDALE	827	24	1	67	12	12	17	582	26	44	33	2	7
ANDERSON	1,974	6	1	373	34	21	52	1,095	42	206	88	0	56
BAMBERG	1,359	25	1	120	17	16	17	1,034	9	78	32	3	7
BARNWELL	1,430	20	1	113	19	14	17	1,085	9	81	31	14	26
BEAUFORT	2,245	25	26	123	40	22	43	1,705	29	115	30	1	86
BERKELEY	7,151	30	10	177	21	23	61	6,290	29	255	35	51	169
CALHOUN	1,468	23	1	119	13	11	16	1,091	9	80	34	2	69
CHARLESTON	3,834	29	49	207	31	27	107	2,139	28	227	40	528	422
CHEROKEE	1,774	10	1	199	25	10	32	1,207	42	109	97	0	42
CHESTER	1,442	14	1	154	12	11	27	973	40	93	72	7	38
CHESTERFIELD	3,322	22	1	122	14	16	27	2,944	9	86	58	4	19
CLARENDON	4,371	29	1	148	17	24	19	3,965	9	115	37	1	6
COLLETON	5,116	29	24	174	19	14	30	4,622	29	117	41	2	15
DARLINGTON	3,209	26	2	155	16	18	18	2,756	18	110	46	0	44
DILLON	1,875	24	1	110	16	11	15	1,548	13	75	46	0	16
DORCHESTER	3,249	29	2	145	28	13	38	2,567	28	150	38	162	49
EDGEFIELD	1,039	11	1	98	9	15	12	767	9	66	38	3	10
FAIRFIELD	2,446	16	1	132	11	19	24	1,517	9	72	56	557	32
FLORENCE	5,170	31	2	174	30	22	34	4,609	18	134	41	1	74
GEORGETOWN	3,198	25	18	118	26	12	101	2,696	16	67	30	2	87
GREENVILLE	2,171	7	1	211	32	15	42	1,179	43	343	135	6	157
GREENWOOD	1,908	11	1	85	25	8	19	1,483	42	125	62	3	44
HAMPTON	2,336	26	1	177	20	13	30	1,947	28	48	37	0	9
HORRY	4,223	24	20	98	33	23	38	3,672	18	193	34	0	70
JASPER	3,974	23	7	162	9	9	19	3,620	29	57	32	0	7
KERSHAW	2,904	22	1	119	20	21	22	2,443	9	110	52	5	80
LANCASTER	1,551	17	1	262	17	7	40	1,037	9	83	64	0	14
LAURENS	1,614	10	1	111	21	15	21	1,147	42	137	79	5	25
LEE	2,373	25	1	337	14	10	26	1,838	9	69	42	1	1
LEXINGTON	5,390	24	2	106	22	21	25	4,717	9	244	42	7	171
MARION	1,284	26	2	106	20	7	19	965	17	80	39	0	3
MARLBORO	2,070	21	2	88	18	10	18	1,749	20	65	51	2	26
MCCORMICK	1,066	10	1	154	10	15	13	751	9	48	39	8	8
NEWBERRY	1,395	15	1	220	19	25	31	892	9	101	54	20	8
OCONEE	1,687	5	1	264	25	19	23	966	43	158	126	11	46
ORANGEBURG	6,028	31	1	227	28	33	43	5,192	9	189	32	22	221
PICKENS	2,007	5	1	303	23	19	39	1,247	43	152	124	6	45
RICHLAND	2,619	25	1	131	29	29	24	2,007	9	185	42	21	116
SALUDA	1,365	13	1	387	21	8	11	799	9	66	40	2	8
SPARTANBURG	2,231	9	1	199	37	17	72	1,254	42	286	111	6	197
SUMTER	3,508	26	1	182	23	20	20	2,969	9	117	41	1	99
UNION	1,248	12	2	86	26	11	33	838	42	99	80	5	14
WILLIAMSBURG	7,393	30	2	230	17	10	17	6,946	17	76	33	0	15
YORK	1,496	11	1	41	28	17	36	902	40	147	83	1	189

TABLE 4.T.2—FUTURE ANNUAL PROBABILITY OF HAZARD

FUTURE ANNUAL PROBABILITY OF HAZARD BY COUNTY (% Chance Per Year)													
County	Total Hazards	Hurricane	Coastal	Severe Storm	Lightning	Tornado	Flood	Wildfire	Drought	Hail	Winter Storms	Earthquake	HAZMAT
ABBEVILLE	1,754	15.38	1.92	269.23	34.62	25.00	36.54	5,588	80.77	167.31	125.00	4.47	27.27
AIKEN	4,565	36.54	1.92	469.23	48.08	59.62	36.54	16,467	17.31	294.23	65.38	1.60	331.82
ALLENDALE	827	46.15	1.92	128.85	23.08	23.08	32.69	2,425	50.00	84.62	63.46	0.64	31.82
ANDERSON	1,974	11.54	1.92	717.31	65.38	40.38	100.00	4,563	80.77	396.15	169.23	0.00	254.55
BAMBERG	1,359	48.08	1.92	230.77	32.69	30.77	32.69	4,308	17.31	150.00	61.54	0.96	31.82
BARNWELL	1,430	38.46	1.92	217.31	36.54	26.92	32.69	4,521	17.31	155.77	59.62	4.47	118.18
BEAUFORT	2,245	48.08	50.00	236.54	76.92	42.31	82.69	7,104	55.77	221.15	57.69	0.32	390.91
BERKELEY	7,151	57.69	19.23	340.38	40.38	44.23	117.31	26,208	55.77	490.38	67.31	16.29	768.18
CALHOUN	1,468	44.23	1.92	228.85	25.00	21.15	30.77	4,546	17.31	153.85	65.38	0.64	313.64
CHARLESTON	3,834	55.77	94.23	398.08	59.62	51.92	205.77	8,913	53.85	436.54	76.92	168.69	1918.18
CHEROKEE	1,774	19.23	1.92	382.69	48.08	19.23	61.54	5,029	80.77	209.62	186.54	0.00	190.91
CHESTER	1,442	26.92	1.92	296.15	23.08	21.15	51.92	4,054	76.92	178.85	138.46	2.24	172.73
CHESTERFIELD	3,322	42.31	1.92	234.62	26.92	30.77	51.92	12,267	17.31	165.38	111.54	1.28	86.36
CLARENDON	4,371	55.77	1.92	284.62	32.69	46.15	36.54	16,521	17.31	221.15	71.15	0.32	27.27
COLLETON	5,116	55.77	46.15	334.62	36.54	26.92	57.69	19,258	55.77	225.00	78.85	0.64	68.18
DARLINGTON	3,209	50.00	3.85	298.08	30.77	34.62	34.62	11,483	34.62	211.54	88.46	0.00	200.00
DILLON	1,875	46.15	1.92	211.54	30.77	21.15	28.85	6,450	25.00	144.23	88.46	0.00	72.73
DORCHESTER	3,249	55.77	3.85	278.85	53.85	25.00	73.08	10,696	53.85	288.46	73.08	51.76	222.73
EDGEFIELD	1,039	21.15	1.92	188.46	17.31	28.85	23.08	3,196	17.31	126.92	73.08	0.96	45.45
FAIRFIELD	2,446	30.77	1.92	253.85	21.15	36.54	46.15	6,321	17.31	138.46	107.69	177.96	145.45
FLORENCE	5,170	59.62	3.85	334.62	57.69	42.31	65.38	19,204	34.62	257.69	78.85	0.32	336.36
GEORGETOWN	3,198	48.08	34.62	226.92	50.00	23.08	194.23	11,233	30.77	128.85	57.69	0.64	395.45
GREENVILLE	2,171	13.46	1.92	734.62	61.54	28.85	80.77	4,913	82.69	659.62	259.62	1.92	713.64
GREENWOOD	1,908	21.15	1.92	380.77	48.08	15.38	36.54	6,179	80.77	240.38	119.23	0.96	200.00
HAMPTON	2,336	50.00	1.92	148.08	38.46	25.00	57.69	8,113	53.85	92.31	71.15	0.00	40.91
HORRY	4,223	46.15	38.46	369.23	63.46	44.23	73.08	15,300	34.62	371.15	65.38	0.00	318.18
JASPER	3,974	44.23	13.46	163.46	17.31	17.31	36.54	15,083	55.77	109.62	61.54	0.00	31.82
KERSHAW	2,904	42.31	1.92	315.38	38.46	40.38	42.31	10,179	17.31	211.54	100.00	1.60	363.64
LANCASTER	1,551	32.69	1.92	230.77	32.69	13.46	76.92	4,321	17.31	159.62	123.08	0.00	63.64
LAURENS	1,614	19.23	1.92	519.23	40.38	28.85	40.38	4,779	80.77	263.46	151.92	1.60	113.64
LEE	2,373	48.08	1.92	192.31	26.92	19.23	50.00	7,658	17.31	132.69	80.77	0.32	4.55
LEXINGTON	5,390	46.15	3.85	667.31	42.31	40.38	48.08	19,654	17.31	469.23	80.77	2.24	777.27
MARION	1,284	50.00	3.85	192.31	38.46	13.46	36.54	4,021	32.69	153.85	75.00	0.00	13.64
MARLBORO	2,070	40.38	3.85	213.46	34.62	19.23	34.62	7,288	38.46	125.00	98.08	0.64	118.18
MCCORMICK	1,066	19.23	1.92	148.08	19.23	28.85	25.00	3,129	17.31	92.31	75.00	2.56	36.36
NEWBERRY	1,395	28.85	1.92	303.85	36.54	48.08	59.62	3,717	17.31	194.23	103.85	6.39	36.36
OCONEE	1,687	9.62	1.92	438.46	48.08	36.54	44.23	4,025	82.69	303.85	242.31	3.51	209.09
ORANGEBURG	6,028	59.62	1.92	496.15	53.85	63.46	82.69	21,633	17.31	363.46	61.54	7.03	1004.55
PICKENS	2,007	9.62	1.92	448.08	44.23	36.54	75.00	5,196	82.69	292.31	238.46	1.92	204.55
RICHLAND	2,619	48.08	1.92	582.69	55.77	55.77	46.15	8,363	17.31	355.77	80.77	6.71	527.27
SALUDA	1,365	25.00	1.92	230.77	40.38	15.38	21.15	3,329	17.31	126.92	76.92	0.64	36.36
SPARTANBURG	2,231	17.31	1.92	778.85	71.15	32.69	138.46	5,225	80.77	550.00	213.46	1.92	895.45
SUMTER	3,508	50.00	1.92	365.38	44.23	38.46	38.46	12,371	17.31	225.00	78.85	0.32	450.00
UNION	1,248	23.08	3.85	338.46	50.00	21.15	63.46	3,492	80.77	190.38	153.85	1.60	63.64
WILLIAMSBURG	7,393	57.69	3.85	163.46	32.69	19.23	32.69	28,942	32.69	146.15	63.46	0.00	68.18
YORK	1,496	21.15	1.92	465.38	53.85	32.69	69.23	3,758	76.92	282.69	159.62	0.32	859.09

TABLE 4.T.3—HISTORICAL ANNUALIZED LOSSES

ANNUALIZED LOSSES OF HAZARDS BY COUNTY													
County	**Total Ann. Losses**	**Hurricane**	**Coastal**	**Severe Storm**	**Lightning**	**Tornado**	**Flood**	**Wildfire**	**Drought**	**Hail**	**Winter Storms**	**Earthquake**	**HAZMAT**
ABBEVILLE	$1,216,120	$6,691	$4,887	$29,312	$15,324	$102,118	$74,005	$6,712	$260,434	$8,538	$638,862	$69,236	$0
AIKEN	$1,411,654	$6,805	$6,251	$48,706	$37,329	$144,407	$24,020	$6,712	$260,434	$8,653	$295,911	$572,425	$0
ALLENDALE	$874,606	$62,189	$2,146	$31,225	$16,488	$102,325	$39,092	$6,712	$260,434	$5,138	$299,554	$49,303	$0
ANDERSON	$1,998,966	$6,691	$8,271	$78,013	$170,907	$214,045	$58,353	$6,712	$260,434	$37,478	$682,704	$475,356	$0
BAMBERG	$820,248	$20,045	$5,410	$35,683	$23,851	$5,501	$21,786	$6,712	$260,434	$9,988	$305,836	$125,001	$0
BARNWELL	$977,111	$107,164	$4,422	$36,657	$10,070	$98,703	$23,399	$6,712	$260,434	$10,071	$295,911	$123,567	$0
BEAUFORT	$2,669,376	$264,790	$222,868	$56,881	$62,440	$49,268	$234,393	$25,943	$263,322	$23,987	$258,487	$1,206,997	$0
BERKELEY	$26,037,065	$19,326,072	$30,156	$54,048	$13,238	$219,414	$38,618	$12,207	$263,320	$8,204	$330,731	$5,741,057	$0
CALHOUN	$1,524,871	$714,861	$6,681	$45,374	$6,323	$37,545	$21,127	$6,712	$260,434	$9,050	$306,892	$109,871	$0
CHARLESTON	$52,269,347	$19,329,977	$17,530,328	$88,717	$129,004	$112,802	$195,849	$39,679	$263,320	$37,589	$262,787	$14,279,067	$227
CHEROKEE	$1,498,808	$24,240	$24,003	$57,912	$36,652	$46,345	$83,342	$6,712	$260,434	$29,836	$807,027	$120,032	$2,273
CHESTER	$1,463,277	$354,309	$4,812	$31,251	$5,704	$41,559	$23,078	$6,974	$260,434	$6,664	$625,681	$102,811	$0
CHESTERFIELD	$2,182,148	$952,692	$11,273	$37,181	$8,372	$355,800	$11,702	$6,974	$260,383	$14,771	$355,693	$167,307	$0
CLARENDON	$4,761,923	$3,494,888	$8,175	$31,327	$13,609	$33,993	$20,894	$6,712	$260,383	$13,779	$308,045	$570,116	$0
COLLETON	$1,916,572	$339,390	$133,858	$60,796	$22,455	$7,890	$193,404	$6,712	$263,320	$5,384	$271,864	$611,500	$0
DARLINGTON	$4,799,387	$3,316,755	$12,355	$41,006	$7,236	$202,531	$22,133	$6,712	$260,383	$28,862	$450,097	$451,316	$0
DILLON	$1,449,889	$362,977	$21,188	$35,674	$7,502	$126,255	$17,979	$6,712	$260,383	$28,848	$441,447	$140,924	$0
DORCHESTER	$17,929,489	$13,426,149	$11,863	$39,848	$6,229	$53,186	$35,665	$16,823	$260,429	$7,793	$307,073	$3,764,430	$0
EDGEFIELD	$849,906	$6,691	$16,635	$23,511	$3,304	$102,262	$13,607	$6,712	$260,434	$18,593	$319,152	$79,006	$0
FAIRFIELD	$1,212,998	$210,981	$44,974	$26,598	$5,416	$90,119	$19,740	$6,974	$260,434	$88,241	$366,038	$93,482	$0
FLORENCE	$6,889,371	$3,490,507	$17,978	$348,103	$49,542	$67,855	$87,953	$6,712	$260,383	$277,586	$381,645	$1,901,107	$0
GEORGETOWN	$23,252,292	$19,223,215	$1,787,369	$75,094	$21,029	$58,204	$66,066	$410,951	$263,325	$8,559	$315,290	$1,023,191	$0
GREENVILLE	$2,929,395	$7,038	$11,860	$125,440	$75,499	$77,000	$395,299	$6,712	$260,434	$27,249	$691,841	$1,248,203	$2,818
GREENWOOD	$1,261,816	$6,691	$6,657	$24,197	$10,348	$159,692	$53,610	$6,712	$260,434	$70,114	$422,197	$241,164	$0
HAMPTON	$1,014,104	$75,238	$3,026	$21,692	$11,420	$7,350	$40,533	$6,712	$260,429	$3,833	$460,360	$123,511	$0
HORRY	$24,101,687	$18,295,974	$1,806,182	$177,697	$34,796	$395,946	$280,171	$410,951	$263,325	$41,092	$389,410	$2,006,053	$91
JASPER	$1,014,149	$85,034	$113,308	$43,309	$1,119	$2,072	$124,368	$7,674	$263,320	$2,650	$258,385	$112,910	$0
KERSHAW	$5,565,949	$4,228,120	$50,949	$59,381	$12,078	$115,262	$38,744	$17,181	$260,383	$132,036	$352,659	$299,154	$0
LANCASTER	$5,479,959	$4,315,847	$12,671	$35,006	$11,086	$56,922	$22,589	$6,974	$260,434	$183,050	$358,723	$213,019	$3,636
LAURENS	$1,631,692	$7,038	$9,030	$116,276	$42,749	$348,306	$135,284	$6,712	$260,434	$35,088	$477,826	$192,946	$0
LEE	$4,456,831	$3,494,888	$6,350	$220,488	$6,517	$2,076	$21,174	$6,712	$260,383	$13,352	$308,574	$113,588	$2,727
LEXINGTON	$2,379,540	$21,765	$4,711	$43,859	$43,075	$224,955	$39,672	$6,712	$260,434	$9,500	$307,034	$1,417,822	$0
MARION	$1,259,998	$209,682	$18,254	$29,042	$19,709	$61,050	$15,827	$6,712	$260,383	$19,879	$371,489	$247,971	$0
MARLBORO	$3,283,517	$206,600	$16,650	$1,765,286	$9,632	$432,897	$15,365	$6,712	$260,383	$24,018	$441,803	$104,168	$0
MCCORMICK	$733,400	$62,074	$4,609	$16,336	$7,883	$12,352	$9,751	$6,712	$260,434	$7,977	$319,918	$25,352	$0
NEWBERRY	$1,258,741	$19,739	$20,525	$28,796	$9,676	$202,725	$39,482	$6,712	$260,434	$156,358	$365,842	$148,452	$0
OCONEE	$1,588,140	$6,691	$9,709	$105,573	$27,859	$183,917	$108,215	$6,712	$260,434	$24,684	$676,663	$177,681	$0
ORANGEBURG	$3,157,559	$1,270,866	$6,521	$49,445	$26,897	$69,255	$25,991	$6,712	$260,434	$13,487	$305,836	$1,122,114	$0
PICKENS	$1,812,126	$6,691	$9,789	$114,995	$11,339	$143,603	$257,594	$6,712	$260,434	$19,900	$676,392	$304,678	$0
RICHLAND	$5,612,995	$1,757,371	$4,993	$158,771	$97,365	$325,035	$37,645	$6,712	$260,434	$12,226	$307,760	$2,641,046	$3,636
SALUDA	$914,341	$19,739	$55,779	$26,315	$5,602	$24,533	$18,954	$6,712	$260,434	$109,546	$321,405	$65,322	$0
SPARTANBURG	$3,245,059	$7,038	$142,038	$236,862	$68,403	$82,344	$414,761	$6,712	$260,434	$423,084	$812,649	$790,733	$0
SUMTER	$15,771,191	$13,919,989	$9,252	$41,877	$20,449	$64,602	$22,625	$6,712	$260,383	$20,648	$308,277	$1,096,376	$0
UNION	$1,187,947	$7,038	$4,798	$32,883	$16,253	$18,384	$54,373	$6,974	$260,434	$14,742	$689,592	$82,474	$0
WILLIAMSBURG	$12,716,359	$11,163,179	$13,797	$37,556	$4,064	$35,704	$40,469	$6,712	$260,434	$10,933	$378,589	$764,921	$0
YORK	$8,890,250	$7,233,138	$4,942	$44,362	$22,612	$20,512	$51,995	$6,974	$260,434	$131,387	$625,545	$488,181	$168

TABLE 4.T.4—COUNTY RANK BASED ON ALL HAZARD RISK SCORE

COUNTY RANK BASED ON ALL HAZARD RISK SCORE	
County	**Rank**
CHARLESTON	1
SPARTANBURG	2
GREENVILLE	3
BERKELEY	4
ORANGEBURG	5
ANDERSON	6
HORRY	7
BEAUFORT	8
LEXINGTON	9
FLORENCE	10
YORK	11
RICHLAND	12
PICKENS	13
COLLETON	14
OCONEE	15
DORCHESTER	16
GEORGETOWN	17
AIKEN	18
LAURENS	19
CHEROKEE	20
UNION	21
SUMTER	22
GREENWOOD	23
CLARENDON	24
DARLINGTON	25
WILLIAMSBURG	26
KERSHAW	27
FAIRFIELD	28
CHESTER	29
ABBEVILLE	30
HAMPTON	31
NEWBERRY	32
CHESTERFIELD	33
JASPER	34
MARLBORO	35
MARION	36
DILLON	37
BAMBERG	38
LANCASTER	39
LEE	40
BARNWELL	41
ALLENDALE	42
CALHOUN	43
SALUDA	44
EDGEFIELD	45
MCCORMICK	46

U. PLACE VULNERABILITY

Total All-Hazard Scores for each county were calculated using the sum of the min-max normalized hazard annual future probabilities (**Table 4.U.1**) and the annualized losses (**Table 4.U.2**). This provides a breakdown of which counties are most hazardous in terms of future probability of occurrence and the most hazardous county based on historical annualized losses.

Place Vulnerability (**Figure U.1** and **Figure U.2**) for each county was determined by adding its total all-hazard score and its total social vulnerability (SoVI) score. Choropleth maps for each score category (Place Vulnerability, Hazard Score based on Future Annual Probability, Hazard Score based on Annualized Losses) are provided to give spatial representation of scores. The Place Vulnerability maps and the two bivariate Hazard Score and SoVI maps (**Figure 4.U.3** and **Figure 4.U.4)** were created using standard deviations, where greater than 0.5 standard deviation means elevated; 0.5 to -0.5 means moderate; and less than -0.5 means limited. Overall, Charleston has the highest Place Vulnerability for calculations based on future probability of an event occurring and based on annualized losses of hazard events. Edgefield County scores the lowest in Place Vulnerability for both calculation methods.

Counties that score in the elevated categories for both social vulnerability and hazard score pose more challenges for emergency management than those in the limited categories. Orangeburg and Colleton Counties are elevated in both SoVI and Hazard Score (based on future annual probability), while only Georgetown County is the only elevated county for both SoVI and Hazard Score (based on annualized losses). These two figures present different information; it is important for emergency management to consider multiple factors for planning and mitigation purposes.

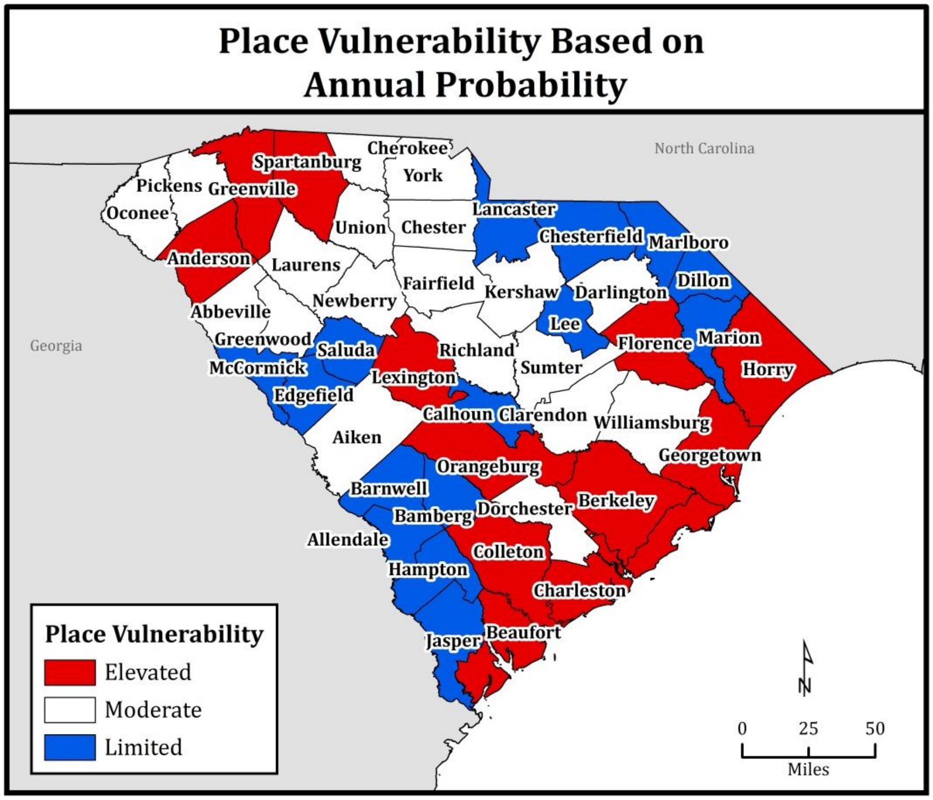


FIGURE 4.U.1—PLACE VULNERABILITY BASED ON FUTURE ANNUAL PROBABILITY OF EVENTS

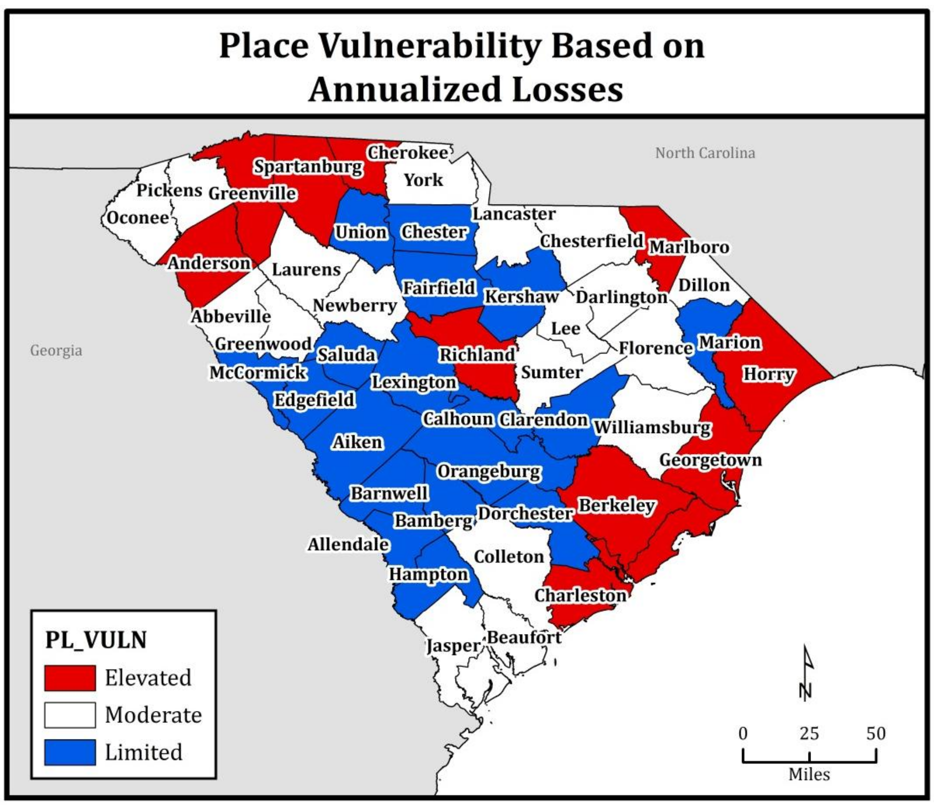


FIGURE 4.U.2—PLACE VULNERABILITY BASED ON FUTURE ANNUALIZED LOSSES OF EVENTS

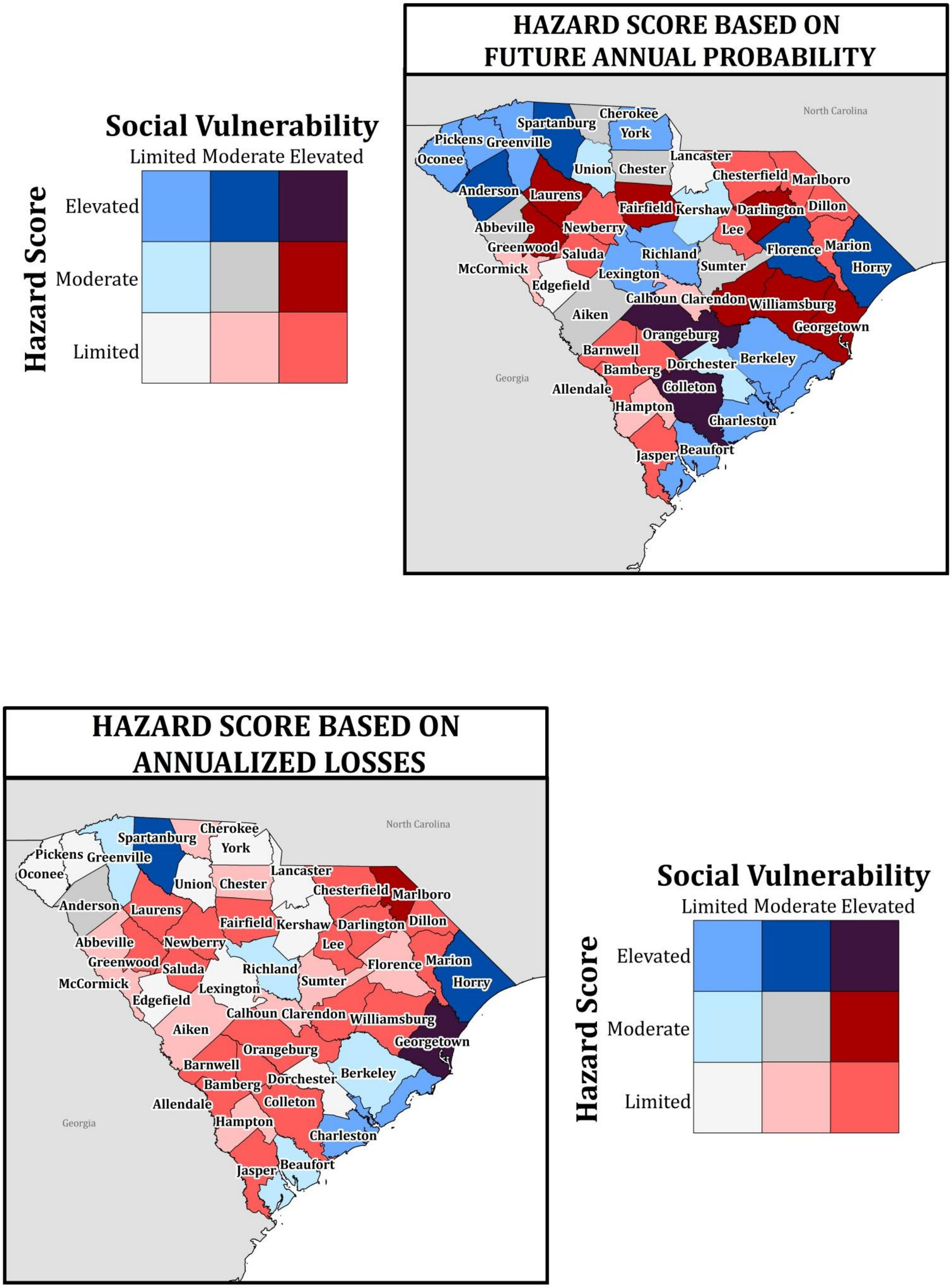


FIGURE 4.U.4—BIVARIATE MAP OF SoVI AND HAZARD SCORE

TABLE 4.U.1—HAZARD SCORE BASED ON FUTURE ANNUAL PROBABILITY

HAZARD SCORE BASED ON FUTURE ANNUAL PROBABILITY OF HAZARD BY COUNTY (Values Min-Max Normalized)															
County	Total All-Hazard Score	Hurricane	Coastal	Severe Storm	Lightning	Tornado	Flood	Wildfire	Drought	Hail	Winter Storms	Earthquake	HAZMAT	SOVI	PLACE VULN.
ABBEVILLE	2.54	0.12	0.00	0.22	0.29	0.23	0.08	0.12	0.97	0.14	0.33	0.03	0.01	0.61	3.15
AIKEN	3.70	0.54	0.00	0.52	0.52	0.92	0.08	0.53	0.00	0.36	0.04	0.01	0.17	0.47	4.16
ALLENDALE	1.63	0.73	0.00	0.00	0.10	0.19	0.06	0.00	0.50	0.00	0.03	0.00	0.01	0.77	2.40
ANDERSON	4.99	0.04	0.00	0.91	0.81	0.54	0.43	0.08	0.97	0.54	0.55	0.00	0.13	0.49	5.48
BAMBERG	1.82	0.77	0.00	0.16	0.26	0.35	0.06	0.07	0.00	0.11	0.02	0.01	0.01	0.82	2.63
BARNWELL	1.66	0.58	0.00	0.14	0.32	0.27	0.06	0.08	0.00	0.12	0.01	0.03	0.06	0.78	2.44
BEAUFORT	4.57	0.77	0.52	0.17	1.00	0.58	0.33	0.18	0.59	0.24	0.00	0.00	0.20	0.39	4.96
BERKELEY	5.73	0.96	0.19	0.33	0.39	0.62	0.52	0.90	0.59	0.71	0.05	0.09	0.40	0.06	5.78
CALHOUN	1.58	0.69	0.00	0.15	0.13	0.15	0.05	0.08	0.00	0.12	0.04	0.00	0.16	0.58	2.16
CHARLESTON	8.27	0.92	1.00	0.41	0.71	0.77	1.00	0.24	0.56	0.61	0.10	0.95	1.00	0.36	8.64
CHEROKEE	3.45	0.19	0.00	0.39	0.52	0.12	0.22	0.10	0.97	0.22	0.64	0.00	0.10	0.67	4.13
CHESTER	2.66	0.35	0.00	0.26	0.10	0.15	0.17	0.06	0.91	0.16	0.40	0.01	0.09	0.47	3.13
CHESTERFIELD	2.32	0.65	0.00	0.16	0.16	0.35	0.17	0.37	0.00	0.14	0.27	0.01	0.04	0.79	3.11
CLARENDON	3.01	0.92	0.00	0.24	0.26	0.65	0.08	0.53	0.00	0.24	0.07	0.00	0.01	0.71	3.72
COLLETON	4.12	0.92	0.48	0.32	0.32	0.27	0.20	0.63	0.59	0.24	0.10	0.00	0.03	0.84	4.96
DARLINGTON	2.89	0.81	0.02	0.26	0.23	0.42	0.07	0.34	0.26	0.22	0.15	0.00	0.10	0.76	3.66
DILLON	1.84	0.73	0.00	0.13	0.23	0.15	0.04	0.15	0.12	0.10	0.15	0.00	0.04	0.89	2.73
DORCHESTER	4.01	0.92	0.02	0.23	0.61	0.23	0.28	0.31	0.56	0.35	0.08	0.29	0.11	0.04	4.04
EDGEFIELD	0.85	0.23	0.00	0.09	0.00	0.31	0.01	0.03	0.00	0.07	0.08	0.01	0.02	0.23	1.08
FAIRFIELD	2.84	0.42	0.00	0.19	0.06	0.46	0.14	0.15	0.00	0.09	0.25	1.00	0.07	0.79	3.63
FLORENCE	4.31	1.00	0.02	0.32	0.68	0.58	0.24	0.63	0.26	0.30	0.10	0.00	0.17	0.61	4.92
GEORGETOWN	3.78	0.77	0.35	0.15	0.55	0.19	0.94	0.33	0.21	0.08	0.00	0.00	0.20	0.81	4.58
GREENVILLE	5.86	0.08	0.00	0.93	0.74	0.31	0.32	0.09	1.00	1.00	1.00	0.01	0.37	0.41	6.26
GREENWOOD	3.05	0.23	0.00	0.39	0.52	0.04	0.08	0.14	0.97	0.27	0.30	0.01	0.10	0.78	3.84
HAMPTON	2.49	0.81	0.00	0.03	0.35	0.23	0.20	0.21	0.56	0.01	0.07	0.00	0.02	0.60	3.09
HORRY	4.62	0.73	0.40	0.37	0.77	0.62	0.28	0.49	0.26	0.50	0.04	0.00	0.16	0.50	5.12
JASPER	2.17	0.69	0.13	0.05	0.00	0.08	0.08	0.48	0.59	0.04	0.02	0.00	0.01	0.74	2.91
KERSHAW	2.87	0.65	0.00	0.29	0.35	0.54	0.11	0.29	0.00	0.22	0.21	0.01	0.19	0.32	3.19
LANCASTER	1.74	0.46	0.00	0.16	0.26	0.00	0.30	0.07	0.00	0.13	0.32	0.00	0.03	0.43	2.16
LAURENS	3.49	0.19	0.00	0.60	0.39	0.31	0.10	0.09	0.97	0.31	0.47	0.01	0.06	0.85	4.35
LEE	1.70	0.77	0.00	0.10	0.16	0.12	0.16	0.20	0.00	0.08	0.11	0.00	0.00	0.88	2.58
LEXINGTON	4.53	0.73	0.02	0.83	0.42	0.54	0.15	0.65	0.00	0.67	0.11	0.01	0.40	0.20	4.73
MARION	1.87	0.81	0.02	0.10	0.35	0.00	0.08	0.06	0.24	0.12	0.09	0.00	0.00	0.94	2.81
MARLBORO	2.09	0.62	0.02	0.13	0.29	0.12	0.07	0.18	0.32	0.07	0.20	0.00	0.06	0.74	2.83
MCCORMICK	0.74	0.19	0.00	0.03	0.03	0.31	0.02	0.03	0.00	0.01	0.09	0.01	0.02	0.45	1.19
NEWBERRY	2.40	0.38	0.00	0.27	0.32	0.69	0.21	0.05	0.00	0.19	0.23	0.04	0.02	0.76	3.16
OCONEE	4.06	0.00	0.00	0.48	0.52	0.46	0.13	0.06	1.00	0.38	0.91	0.02	0.11	0.41	4.47
ORANGEBURG	5.30	1.00	0.00	0.57	0.61	1.00	0.33	0.72	0.00	0.48	0.02	0.04	0.52	0.76	6.06
PICKENS	4.17	0.00	0.00	0.49	0.45	0.46	0.29	0.10	1.00	0.36	0.90	0.01	0.10	0.21	4.38
RICHLAND	4.21	0.77	0.00	0.70	0.65	0.85	0.14	0.22	0.00	0.47	0.11	0.04	0.27	0.27	4.49
SALUDA	1.11	0.31	0.00	0.16	0.39	0.04	0.00	0.03	0.00	0.07	0.10	0.00	0.02	1.00	2.11
SPARTANBURG	6.21	0.15	0.00	1.00	0.90	0.38	0.64	0.11	0.97	0.81	0.77	0.01	0.47	0.48	6.69
SUMTER	3.18	0.81	0.00	0.36	0.45	0.50	0.09	0.38	0.00	0.24	0.10	0.00	0.23	0.51	3.68
UNION	3.25	0.27	0.02	0.32	0.55	0.15	0.23	0.04	0.97	0.18	0.48	0.01	0.03	0.00	3.25
WILLIAMSBURG	2.88	0.96	0.02	0.05	0.26	0.12	0.06	1.00	0.24	0.11	0.03	0.00	0.03	0.88	3.75
YORK	4.27	0.23	0.00	0.52	0.61	0.38	0.26	0.05	0.91	0.34	0.50	0.00	0.45	0.19	4.46

TABLE 4.U.2—HAZARD SCORE BASED ON ANNUALIZED LOSSES

HAZARD SCORE BASED ON ANNUALIZED LOSSES OF HAZARDS BY COUNTY (Values Min-Max Normalized)															
County	**Total All-Hazard Score**	**Hurricane**	**Coastal**	**Severe Storm**	**Lightning**	**Tornado**	**Flood**	**Wildfire**	**Drought**	**Hail**	**Winter Storms**	**Earthquake**	**HAZMAT**	**SOVI**	**PLACE VULN.**
ABBEVILLE	1.20	0.00	0.00	0.01	0.08	0.23	0.16	0.00	0.02	0.01	0.69	0.00	0.00	0.61	1.82
AIKEN	0.74	0.00	0.00	0.02	0.21	0.33	0.04	0.00	0.02	0.01	0.07	0.04	0.00	0.47	1.20
ALLENDALE	0.51	0.00	0.00	0.01	0.09	0.23	0.07	0.00	0.02	0.01	0.07	0.00	0.00	0.77	1.28
ANDERSON	2.54	0.00	0.00	0.04	1.00	0.49	0.12	0.00	0.02	0.08	0.77	0.03	0.00	0.49	3.03
BAMBERG	0.31	0.00	0.00	0.01	0.13	0.01	0.03	0.00	0.02	0.02	0.09	0.01	0.00	0.82	1.13
BARNWELL	0.44	0.01	0.00	0.01	0.05	0.22	0.03	0.00	0.02	0.02	0.07	0.01	0.00	0.78	1.22
BEAUFORT	2.25	0.01	0.01	0.02	0.36	0.11	0.55	0.05	1.00	0.05	0.00	0.08	0.00	0.39	2.65
BERKELEY	3.23	1.00	0.00	0.02	0.07	0.50	0.07	0.01	1.00	0.01	0.13	0.40	0.00	0.06	3.28
CALHOUN	0.32	0.04	0.00	0.02	0.03	0.08	0.03	0.00	0.02	0.02	0.09	0.01	0.00	0.58	0.90
CHARLESTON	5.74	1.00	1.00	0.04	0.75	0.26	0.46	0.08	1.00	0.08	0.01	1.00	0.06	0.36	6.11
CHEROKEE	2.22	0.00	0.00	0.02	0.21	0.10	0.18	0.00	0.02	0.06	0.99	0.01	0.63	0.67	2.89
CHESTER	0.87	0.02	0.00	0.01	0.03	0.09	0.03	0.00	0.02	0.01	0.66	0.01	0.00	0.47	1.35
CHESTERFIELD	1.14	0.05	0.00	0.01	0.04	0.82	0.00	0.00	0.00	0.03	0.18	0.01	0.00	0.79	1.93
CLARENDON	0.52	0.18	0.00	0.01	0.07	0.07	0.03	0.00	0.00	0.03	0.09	0.04	0.00	0.71	1.23
COLLETON	1.71	0.02	0.01	0.03	0.13	0.01	0.45	0.00	1.00	0.01	0.02	0.04	0.00	0.84	2.55
DARLINGTON	1.16	0.17	0.00	0.01	0.04	0.47	0.03	0.00	0.00	0.06	0.35	0.03	0.00	0.76	1.92
DILLON	0.78	0.02	0.00	0.01	0.04	0.29	0.02	0.00	0.00	0.06	0.33	0.01	0.00	0.89	1.67
DORCHESTER	1.32	0.69	0.00	0.01	0.03	0.12	0.06	0.03	0.02	0.01	0.09	0.26	0.00	0.04	1.36
EDGEFIELD	0.43	0.00	0.00	0.00	0.01	0.23	0.01	0.00	0.02	0.04	0.11	0.00	0.00	0.23	0.66
FAIRFIELD	0.69	0.01	0.00	0.01	0.03	0.20	0.02	0.00	0.02	0.20	0.19	0.00	0.00	0.79	1.48
FLORENCE	2.01	0.18	0.00	0.19	0.29	0.15	0.19	0.00	0.00	0.65	0.22	0.13	0.00	0.61	2.62
GEORGETOWN	3.70	0.99	0.10	0.03	0.12	0.13	0.14	1.00	1.00	0.01	0.10	0.07	0.00	0.81	4.51
GREENVILLE	3.35	0.00	0.00	0.06	0.44	0.17	0.95	0.00	0.02	0.06	0.78	0.09	0.78	0.41	3.75
GREENWOOD	1.02	0.00	0.00	0.00	0.05	0.37	0.11	0.00	0.02	0.16	0.30	0.02	0.00	0.78	1.81
HAMPTON	0.55	0.00	0.00	0.00	0.06	0.01	0.08	0.00	0.02	0.00	0.36	0.01	0.00	0.60	1.14
HORRY	5.41	0.95	0.10	0.09	0.20	0.91	0.67	1.00	1.00	0.09	0.24	0.14	0.03	0.50	5.92
JASPER	1.32	0.00	0.01	0.02	0.00	0.00	0.28	0.00	1.00	0.00	0.00	0.01	0.00	0.74	2.06
KERSHAW	1.17	0.22	0.00	0.02	0.06	0.26	0.07	0.03	0.00	0.31	0.17	0.02	0.00	0.32	1.49
LANCASTER	2.09	0.22	0.00	0.01	0.06	0.13	0.03	0.00	0.02	0.43	0.18	0.01	1.00	0.43	2.52
LAURENS	1.92	0.00	0.00	0.06	0.25	0.80	0.31	0.00	0.02	0.08	0.40	0.01	0.00	0.85	2.77
LEE	1.23	0.18	0.00	0.12	0.03	0.00	0.03	0.00	0.00	0.03	0.09	0.01	0.75	0.88	2.11
LEXINGTON	1.07	0.00	0.00	0.02	0.25	0.52	0.07	0.00	0.02	0.02	0.09	0.10	0.00	0.20	1.28
MARION	0.54	0.01	0.00	0.01	0.11	0.14	0.02	0.00	0.00	0.04	0.20	0.02	0.00	0.94	1.48
MARLBORO	2.46	0.01	0.00	1.00	0.05	1.00	0.01	0.00	0.00	0.05	0.33	0.01	0.00	0.74	3.21
MCCORMICK	0.21	0.00	0.00	0.00	0.04	0.02	0.00	0.00	0.02	0.01	0.11	0.00	0.00	0.45	0.66
NEWBERRY	1.18	0.00	0.00	0.01	0.05	0.47	0.07	0.00	0.02	0.37	0.19	0.01	0.00	0.76	1.94
OCONEE	1.71	0.00	0.00	0.05	0.16	0.42	0.24	0.00	0.02	0.05	0.75	0.01	0.00	0.41	2.12
ORANGEBURG	0.64	0.07	0.00	0.02	0.15	0.16	0.04	0.00	0.02	0.03	0.09	0.08	0.00	0.76	1.39
PICKENS	1.89	0.00	0.00	0.06	0.06	0.33	0.61	0.00	0.02	0.04	0.75	0.02	0.00	0.21	2.10
RICHLAND	2.87	0.09	0.00	0.08	0.57	0.75	0.07	0.00	0.02	0.02	0.09	0.18	1.00	0.27	3.14
SALUDA	0.50	0.00	0.00	0.01	0.03	0.05	0.02	0.00	0.02	0.25	0.11	0.00	0.00	1.00	1.50
SPARTANBURG	3.79	0.00	0.01	0.13	0.40	0.19	1.00	0.00	0.02	1.00	1.00	0.05	0.00	0.48	4.27
SUMTER	1.23	0.72	0.00	0.01	0.11	0.15	0.03	0.00	0.00	0.04	0.09	0.08	0.00	0.51	1.74
UNION	1.08	0.00	0.00	0.01	0.09	0.04	0.11	0.00	0.02	0.03	0.78	0.00	0.00	0.00	1.08
WILLIAMSBURG	1.07	0.58	0.00	0.01	0.02	0.08	0.08	0.00	0.02	0.02	0.22	0.05	0.00	0.88	1.95
YORK	1.73	0.37	0.00	0.02	0.13	0.04	0.10	0.00	0.02	0.31	0.66	0.03	0.05	0.19	1.92

V. CHANGES FROM THE LAST PLAN

Many changes were made in this plan. The most significant change was combining the three sections that comprised the Risk Assessment in the 2010 Hazard Mitigation Plan into one section for this update. This allowed each hazard to be identified and analyzed in one continuous section rather than breaking it out into three separate sections. Another important change was updating the hazard data and analysis. The last plan analyzed recent event data from 2007 through 2009. This plan incorporated data from 2009 to 2011. This added three years of analysis to our historical events tables and future probability calculations. Sea level rise and sinkhole hazards were added to the plan this update cycle, as well as, improved methodologies for wildfire and erosion analysis.

V. INTEGRATION OF LOCAL HAZARD MITIGATION PLANS

This section was added in the 2007 plan and updated in both the 2010 and 2013 plans. Updates include a revised county inventory (Table 5.1) and a revised hazard list. This section discusses:

1. The status of local mitigation planning in South Carolina,
2. An overview of the hazards addressed in the local plans, and
3. An overview of the findings of the Risk Assessments from the local plans

A. STATUS OF LOCAL PLANS IN SOUTH CAROLINA

Local governments across the State of South Carolina have developed Hazard Mitigation Plans for their jurisdictions. Most of these plans have been developed by counties and are multi-jurisdictional, including local municipalities and townships. There are six (6) specific municipalities that have developed their own Plan separate from their county to address their specific interest identified within their jurisdiction. **Table 5.1** provides a listing of all jurisdictions in South Carolina, the status of their Hazard Mitigation Plan approval (by FEMA), the name and type of plan in which they are included. This list was last updated with current information January 16, 2013. A list of municipalities and townships that have adopted and stated their approval in a resolution may be found in **Appendix B.**

Local governments are responsible in the preparation and adoption of a jurisdiction-wide natural hazard mitigation plan as a condition of receiving project grant funds under the HMGP. They also are required to review and, if necessary, update the local mitigation plan every five (5) years from date of plan approval to continue program eligibility. Local plans scheduled to be updated may request to meet with the SCEMD planning staff to discuss the update process. It is recommended that they begin this process as soon as their plan is officially approved by FEMA and adopted by the local communities. The SCEMD planning staff is available to provide technical assistance and guidance to the local community throughout the five year update cycle. The local community will then submit their updated plan to SCEMD for review. Utilizing the latest version of the Local Mitigation Plan Review Crosswalk, the plan is reviewed for completion and feasibility. If any requirements are not met, the plan is sent back to the local government for review. Once SCEMD finds the plan to be completed, the final plan is submitted to FEMA for official review and approval.

Upon approval from FEMA, local plans are integrated into the State Plan by:

- Updating risks identified in the local plans and incorporating it into the State Plan (Table 5.2)

- Ensuring that all local mitigation goals are reflected in the goals and prioritization of State Mitigation Goals
- Adding initiatives that have proven successful at the local level
- Reviewing existing state initiatives to determine if they are still meeting the overall mitigation needs of the state
- Changing or eliminating existing mitigation initiatives that have not produced the anticipated results

The State of South Carolina continues to strive to reach its goal to have all 46 of its counties and their incorporated jurisdictions, submit local mitigation plans that are in compliance of the 44 CFR Part 201. In 2008 and 2009 the State of South Carolina was successful in achieving 100% coverage as all 46 counties had FEMA approve local hazard mitigation plans. In 2012, the majority of county plans have been re-written and approved with the earliest expiration date in early 2014. In order for a mitigation plan to be approved, it must be compliant to the DMA 2000 and meet all of the requirements as set by 44 CFR Part 201.

SCEMD's knowledge of and ability to analyze local risk, as well as integrate this knowledge into the state plan, will continue to improve through the local mitigation plans currently being developed. This effort will continue through future enhancements to this plan as more standardized local risk assessment data becomes available through the submission of local hazard mitigation plans.

TABLE 5.1—STATUS OF HAZARD MITIGATION PLAN DEVELOPMENT

Jurisdiction	Plan Status	Name/Type	Date Expires
City Of Greenville	Approved	City Of Greenville Hazard Mitigation Plan	7/15/2015
City Of Greer	Approved	City Of Greer Hazard Mitigation Plan	11/7/2015
City Of Myrtle Beach	Approved	City Of Myrtle Beach Hazard Mitigation Plan	1/5/2016
City Of North Myrtle Beach	Approved	City Of North Myrtle Beach Hazard Mitigation Plan	4/17/2016
City Of Simpsonville	Approved	City Of Simpsonville Hazard Mitigation Plan	10/11/2015
Town Of Santee	Approved	Town Of Santee Hazard Mitigation Plan	1/3/2016
Abbeville County	Approved	Abbeville County Plan (Multi-Jurisdictional)	3/20/2016
Aiken County	Approved	Aiken County Plan (Multi-Jurisdictional)	4/6/2016
Allendale County	Approved	Allendale County Plan (Multi-Jurisdictional)	5/29/2016
Anderson County	Approved	Western Piedmont Regional Emergency Management Task Force Regional Hazard Mitigation Plan (Multi-Jurisdiction)	5/30/2017
Bamberg County	Approved	Bamberg County Plan (Multi-Jurisdictional)	4/19/2016
Barnwell County	Approved	Barnwell County Plan (Multi-Jurisdictional)	12/22/2015
Beaufort County	Approved	Beaufort County Plan (Multi-Jurisdictional)	9/28/2016
Berkeley County	Approved	Berkeley-Dorchester Hazard Mitigation Plan (Multi-Jurisdiction)	11/14/2015
Calhoun County	Approved	Calhoun County Hazard Mitigation Plan (Multi-Jurisdiction)	11/9/2015
Charleston County	Approved	Charleston Regional Hazard Mitigation Plan (Multi-Jurisdictional)	2/5/2014
Cherokee County	Approved	Cherokee County Hazard Plan (Multi-Jurisdiction)	11/16/2016
Chester County	Approved	Chester County Hazard Mitigation (Multi-Jurisdiction)	8/14/2016
Chesterfield County	Approved	Chesterfield County Hazard Mitigation Plan (Multi-Jurisdictional)	5/14/2017
Clarendon County	Approved	Santee-Lynches Hazard Mitigation Plan (Multi-Jurisdiction)	6/14/2015
Colleton County	Approved	Lowcountry Region Natural Hazard Mitigation Plan (Multi-Jurisdiction)	11/7/2015
Darlington County	Approved	Darlington County Hazard Mitigation Plan (Multi-Jurisdiction)	5/4/2017
Dillon County	Approved	Dillon County Hazard Mitigation Plan (Multi-Jurisdiction)	3/30/2017

Dorchester County	Approved	Berkeley-Dorchester Hazard Mitigation Plan (Multi-Jurisdiction)	11/14/2015
Edgefield County	Approved	Edgefield County Hazard Mitigation Plan (Multi-Jurisdiction)	7/18/2015
Fairfield County	Approved	Central Midlands Regional Hazard Mitigation Plan (Multi-Jurisdiction)	8/14/2016
Florence County	Expired	Florence County Natural Hazard Mitigation (Multi-Jurisdiction)	4/17/2012
Georgetown County	Approved	Georgetown County Hazard Mitigation Plan (Multi-Jurisdiction)	9/15/2014
Greenville County	Approved	Greenville County Hazard Mitigation Plan	1/13/2015
Greenwood County	Approved	Greenwood County Hazard Mitigation Plan (Multi-Jurisdiction)	3/31/2015
Hampton County	Approved	Lowcountry Region Natural Hazard (Multi-Jurisdiction)	11/7/2015
Horry County	Approved	Horry County All-Hazards Mitigation Plan (Multi-Jurisdiction)	1/6/2016
Jasper County	Approved	Lowcountry Region Natural Hazard (Multi-Jurisdiction)	11/7/2015
Kershaw County	Approved	Santee-Lynches Hazard Mitigation Plan (Multi-Jurisdiction)	6/14/2015
Lancaster County	Approved	Lancaster County Hazard Mitigation Plan (Multi-Jurisdiction)	5/7/2017
Laurens County	Approved	Laurens County Hazard Mitigation Plan (Multi-Jurisdiction)	11/7/2015
Lee County	Approved	Santee-Lynches Hazard Mitigation Plan (Multi-Jurisdiction)	6/14/2015
Lexington County	Approved	Central Midlands Regional Hazard Mitigation (Multi-Jurisdiction)	8/14/2016
Marion County	Approved	Marion County Hazard Mitigation Plan (Multi-Jurisdiction)	6/3/2017
Marlboro County	Approved	Marlboro County Hazard Mitigation (Multi-Jurisdiction)	6/28/2017
McCormick County	Approved	McCormick County Hazard Mitigation Plan (Multi-Jurisdiction)	1/3/2016
Newberry County	Approved	Central Midlands Regional Hazard Mitigation (Multi-Jurisdiction)	8/14/2016
Oconee County	Approved	Western Piedmont Regional Emergency Management Task Force Regional Hazard Mitigation Plan (Multi-Jurisdiction)	5/30/2017
Orangeburg County	Approved	Orangeburg County Hazard Mitigation Plan (Multi-Jurisdiction)	2/3/2017
Pickens County	Approved	Pickens County Hazard Mitigation Plan	9/5/2017
Richland County	Approved	Central Midlands Regional Hazard Mitigation (Multi-Jurisdiction)	8/14/2016
Saluda County	Approved	Saluda County Hazard Mitigation Plan (Multi-Jurisdiction)	6/20/2015
Spartanburg County	Approved	Spartanburg County Hazard Mitigation Plan (Multi-Jurisdictional)	8/20/2017

Sumter County	Approved	Santee-Lynches Hazard Mitigation Plan (Multi-Jurisdiction)	6/14/2015
Union County	Expired	Union County Hazard Mitigation Plan (Multi-Jurisdiction)	12/19/2012
Williamsburg County	Approved	Williamsburg County Hazard Mitigation Plan (Multi-Jurisdiction)	7/10/2016
York County	Approved	York County Hazard Mitigation Plan (Multi-Jurisdiction)	9/17/2017

B. OVERVIEW OF HAZARDS ADDRESSED IN LOCAL PLAN

Table 5.2 provides a summary of the hazards that have been evaluated in the local plans in comparison to the hazards identified and evaluated in the state plan. The headings of **Table 5.2** provide a listing of the hazards found in this plan. Jurisdictions highlighted in Blue are municipalities or townships that have community specific plans. An (x) has been entered into the cells for each local plan to indicate whether or not the hazard was addressed in that plan.

TABLE 5.2—OVERVIEW OF HAZARDS ADDRESSED IN LOCAL PLAN

Jurisdiction	Flood	Hurricanes and Coastal Storms	Severe Thunder-Storms, Tornadoes and Lightning	Wildfire	Drought/ Extreme Heat	Winter Storms and Freezes	Hail	Erosion	Dam/ Levee Failure	Earthquakes Sinkholes, Landslides	Tsunami	Other Hazards (Not Included In State Plan)
Abbeville County	X	X	X	X	X	X	X			X		Structure fires, Windstorms, hazardous materials, terrorism
Aiken County	X	X	X	X	X	X	X			X		
Allendale County	X	X	X	X	X	X	X			X		
Anderson County	X	X	X	X	X	X	X			X		
Bamberg County	X	X	X	X	X	X	X			X		
Barnwell County	X	X	X	X	X	X	X			X		
Beaufort County	X	X	X	X	X				X	X	X	Hazardous Materials
Berkeley County	X	X	X	X	X	X	X		X	X	X	
Calhoun County	X	X	X	X	X	X	X			X		

Jurisdiction	Flood	Hurricanes and Coastal Storms	Severe Thunder-Storms, Tornadoes and Lightning	Wildfire	Drought/ Extreme Heat	Winter Storms and Freezes	Hail	Erosion	Dam/ Levee Failure	Earthquakes Sinkholes, Landslides	Tsunami	Other Hazards (Not Included In State Plan)
Charleston County	X	X	X	X	X	X	X	X	X	X	X	Hazardous Materials, Terrorism, Rip Currents, Avian Flu/Pandemic Disease
Cherokee County	X	X	X	X	X	X	X			X		
Chester County	X	X	X	X	X	X	X		X	X		Windstorms
Chesterfield County	X	X	X	X	X	X	X			X		Windstorm, Nuclear Emergency. Fixed hazardous materials locations.
Clarendon County	X	X	X	X	X	X	X		X	X		
Colleton County	X	X	X	X	X	X	X	X		X		
Darlington County	X	X	X	X	X	X	X		X	X		Radiological Incident. Fixed hazardous materials locations, rail/highway transportation route hazards
Dillon County	X	X	X	X	X	X	X			X		Structure fires, Hazardous Materials, Windstorms.

Jurisdiction	Flood	Hurricanes and Coastal Storms	Severe Thunder-Storms, Tornadoes and Lightning	Wildfire	Drought/ Extreme Heat	Winter Storms and Freezes	Hail	Erosion	Dam/ Levee Failure	Earthquakes Sinkholes, Landslides	Tsunami	Other Hazards (Not Included In State Plan)
Dorchester County	X	X	X	X	X	X	X		X	X	X	
Edgefield County	X	X	X	X	X	X	X			X		Structural fire, hazardous materials, terrorism, Windstorm
Fairfield County	X	X	X	X	X	X				X		
Florence County	X	X	X	X	X	X	X			X		Nuclear Emergency, Fixed hazardous materials locations, rail/highway transportation hazards
Georgetown County	X	X	X	X		X	X		X	X		
Greenville County	X	X	X	X	X	X			X	X		
Greenville	X	X	X	X	X	X			X	X		
Greer	X	X	X	X	X	X			X	X		
Simpsonville	X	X	X	X	X	X			X	X		

Jurisdiction	Flood	Hurricanes and Coastal Storms	Severe Thunder-Storms, Tornadoes and Lightning	Wildfire	Drought/ Extreme Heat	Winter Storms and Freezes	Hail	Erosion	Dam/ Levee Failure	Earthquakes Sinkholes, Landslides	Tsunami	Other Hazards (Not Included In State Plan)
Greenwood County	X	X	X	X	X	X	X		X	X		Structural fire, hazardous materials, terrorism
Hampton County	X	X	X	X	X	X	X	X		X		
Horry County	X	X	X	X	X	X			X	X	X	Storm surge
Myrtle Beach	X	X	X	X	X	X		X	X	X	X	Nor'easters, Hazardous Materials, Airplane Crash, Acts of Terror
North Myrtle Beach	X	X	X	X	X	X		X	X	X	X	Nor'easters, sinkholes
Jasper County	X	X	X	X	X	X	X	X		X		
Kershaw County	X	X	X	X	X	X	X		X	X		
Lancaster County	X	X	X	X	X	X	X			X		
Laurens County	X	X	X	X	X	X				X		Structural fire, hazardous materials, terrorism

Jurisdiction	Flood	Hurricanes and Coastal Storms	Severe Thunder-Storms, Tornadoes and Lightning	Wildfire	Drought/ Extreme Heat	Winter Storms and Freezes	Hail	Erosion	Dam/ Levee Failure	Earthquakes Sinkholes, Landslides	Tsunami	Other Hazards (Not Included In State Plan)
Lee County	X	X	X	X	X	X	X		X	X		
Lexington County	X	X	X	X	X	X	X			X		
Marion County	X	X	X	X	X	X	X			X		Nuclear Emergency, Fixed hazardous materials locations, rail/highway transportation hazards
Marlboro County	X	X	X	X	X	X	X			X		Nuclear Emergency, Fixed hazardous materials locations, rail/highway transportation hazards
McCormick County	X	X	X	X	X	X	X			X		Structure fire, Hazardous Materials, Terrorism
Newberry County	X	X	X	X	X	X	X			X		
Oconee County	X	X	X	X	X	X	X			X		
Orangeburg County	X	X	X	X	X	X	X			X		
Santee	X	X	X	X	X	X	X			X		

Jurisdiction	Flood	Hurricanes and Coastal Storms	Severe Thunder-Storms, Tornadoes and Lightning	Wildfire	Drought/ Extreme Heat	Winter Storms and Freezes	Hail	Erosion	Dam/ Levee Failure	Earthquakes Sinkholes, Landslides	Tsunami	Other Hazards (Not Included In State Plan)
Pickens County	X	X	X	X	X	X	X			X		
Richland County	X	X	X	X	X	X	X			X		
Saluda County	X	X	X	X	X	X	X			X		Structure fire, Hazardous Materials, Terrorism
Spartanburg County	X	X	X	X	X	X	X			X		
Sumter County	X	X	X	X	X	X	X		X	X		
Union County	X	X	X	X	X	X	X			X		
Williamsburg County	X	X	X	X	X	X	X		X	X		
York County	X	X	X	X	X	X	X			X		

C. OVERVIEW OF FINDINGS FROM LOCAL RISK ASSESSMENTS

For each county, the Hazards and Vulnerability Research Institute at the University of South Carolina completed a local risk assessment (see Appendix C). The risk assessments provide a summary of the hazards that threaten each county as well as the vulnerabilities and hazard loss estimates.

D. ADDITIONAL LOCAL PLANNING CAPABILITY

Local Hazard Mitigation Plans are just one example of local planning capability. Local communities also have zoning and land development plans, beach management plans, flood ordinances, and development ordinances, which incorporate mitigation strategies. The South Carolina Local Government Comprehensive Planning Enabling Act of 1994 gave local governments the authority to adopt and update comprehensive plans. This act includes the creation of local planning commissions, guidance to developing and redeveloping of its area of jurisdiction, and zoning ordinances to guide development. Plans developed by communities serve as a roadmap to decision making regarding growth and development, public facility investments, regulation of land uses, and economic development initiatives. Because comprehensive plans involve regulated development and design, it is an excellent place to incorporate the local mitigation strategies and actions. For example, the Town of Hilton Head's Comprehensive plan includes the burial of overhead electrical lines. This is a joint effort with the Town and utilities in response to community concerns with the visual quality of the built environment and storm event mitigation.

As a resource to local counties, cities and towns throughout South Carolina, the State established 10 Council of Governments (COG) to work with multi-county districts. They work in partnership with Federal and state agencies, obtaining and administering grants for a variety of community based programs and economic development initiative. Each of the state's 46 counties falls within a COG region. Many local communities include their COG partners in their local mitigation planning process.

Recovery and redevelopment plans are another planning capability that can include mitigation focused priorities. For example, Beaufort County has developed a pre-event plan for post-disaster recovery and reconstruction. The Beaufort County Recovery Plan is composed of policies, plans, implementation actions, and designated responsibilities related to post-disaster recovery and rebuilding, with an emphasis on mitigation. The Plan serves as a guide to the essential recovery functions of Beaufort County following any disaster.

E. DATA LIMITATIONS

With the initial development of local mitigation plans in South Carolina, SCEMD developed a standard methodology for conducting local risk assessment which they encouraged (but did not require) local jurisdictions to utilize in the development of their local hazard mitigation plans. As a result, when the local plans were developed, the counties used a variety of methodologies to complete the local risk assessments. This creates substantial challenges for SCEMD's ability to generalize and integrate local risk assessment data into the State Hazard Mitigation Plan. SCEMD will explore the feasibility of requiring a standardized method for conducting local risk assessments that should assist in overcoming these challenges. SCEMD recognizes that the necessary level of specificity for the plans to incorporate them into the statewide risk assessment is not in place at this time. SCEMD will work with the counties to improve upon the methodology and coordinate the integration of the local plans and local risk assessment data through future revisions to this plan.

F. CHANGES FROM THE LAST PLAN

No major changes were made in this section. All information was updated to reflect the current status of local mitigation plans and hazards addressed. A new attachment was added, Appendix B to provide a listing of each municipality or township that are referenced in the County Plans and their status of adoption by resolution.

VI. STATE CAPABILITY ASSESSMENT

Requirement §201.4(c)(3) (ii): The State mitigation strategy shall include a discussion of the State's pre-and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including:

- ***An evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas; [and]***
- ***A discussion of State funding capabilities for hazard mitigation projects***

EMAP STANDARD
4.4.3: *The Emergency Management Program provides technical assistance consistent with the scope of the mitigation program such as implementing building codes, fire codes, and land-use ordinances.*

The capability assessment serves as an important step in designing an effective mitigation strategy. The data used to perform the capability assessment was obtained through content analysis of relevant documents, and interviews with state officials. The findings and content analysis are summarized in Table 6.1. The assessment includes program descriptions and how they are used to reduce future hazards losses and, where appropriate, an evaluation of where and how these capabilities should be strengthened. In cases where state policies and programs increased hazard vulnerability, recommendations were made to modify or eliminate those activities, whenever possible.

The information discussed throughout this section was gathered from participating state agencies and the Hazard Mitigation Grant Program Administrative Plan (404 Plan). This allowed the South Carolina Emergency Management Division (SCEMD) to document capabilities and incorporate the findings into this plan.

A. PLANS, PROGRAMS, POLICIES, AND FUNDING

The *Capability Assessment* provides part of the foundation for determining the type of mitigation strategy. The assessment process also continues to identify gaps or weaknesses that may need to be addressed through mitigation planning goals and actions deemed practical considering the state's capabilities to implement them. Finally, the *Capability Assessment* highlights the positive measures in place or underway for continued support and enhanced state mitigation efforts.

State Agency Programs

The state maintains an array of departments, agencies, offices, and programs that can directly or indirectly affect the state's ability to reduce the impact of hazards. **Table 6.1** consists of state agencies and their programs, including their effect on hazard loss reduction and severe repetitive loss reduction (SRL) to meet SRL updates. Programs available in a post-disaster environment are designated in italics. This table serves as the basis for the analysis found in the remainder of the assessment. For the column titled, "Effects on Loss Reduction," the following definitions apply:

1. **Support**—Programs, plans, policies, regulations, funding, or practices that help the implementation of mitigation actions.
2. **Facilitate**—Programs, policies, etc. that make implementing mitigation actions easier.
3. **Hinde**r—Programs, policies, etc. that pose obstacles to the implementation of mitigation measures.

The following agencies are listed in the order that they appear in the following state capability assessment table.

1. Budget and Control Board
2. Office of the Adjutant General- Emergency Management Division
3. Governor's Office
4. Department of Archives and History
5. Department of Commerce
6. Department of Education
7. Department of Health and Environmental Control- Office of Ocean and Coastal Resource Management
8. Department of Health and Environmental Control- Bureau of Water
9. Department of Insurance
10. Department of Labor, Licensing and Regulation
11. Department of Labor, Licensing and Regulation- Building Codes Council
12. Department of Natural Resources
13. Department of Transportation
14. Forestry Commission
15. University of South Carolina
16. The Citadel
17. College of Charleston- Department of Geology and Environmental Geosciences
18. Clemson University- Department of Civil Engineering
19. South Carolina Association for Hazard Mitigation

TABLE 6.1—STATE PLANS, POLICIES, PROGRAMS AND GRANTS IMPACTING HAZARD MITIGATION IN SOUTH CAROLINA

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
Budget and Control Board	General Services Division, Facilities Management		X		The mission of Facilities Management is to deliver electrical, mechanical, maintenance, energy management, fire protection, horticultural, custodial, technical training, project management, safety, and building renovation services for state owned buildings in the most efficient manner.
	Insurance & Grant Services, Insurance Reserve Fund		X		The Fund currently provides insurance on real property valued at $29.6 billion. Coverage is provided on an "all risk" form including flooding and earthquake. The flood coverage provided is similar to the National Flood Insurance Program's coverage. This program provides insurance coverage for state and local facilities at a lower cost than commercial insurance.
	Materials Management Office, Office of the State Engineer		X		The State Engineer is designated as the Floodplain Administrator on behalf of the state with respect to state buildings and state development in floodplains. The State Engineer also serves as the Chair of the Variance Committee for all state construction. The State Engineer is also the Building Official for all state-owned buildings and assures that state facilities are built to current building codes.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	Office of Research & Statistics, State Geodetic Survey		X		Mapping coordination performed by this office supports the development of an accurate, uniform statewide mapping system on a county-by-county base. Accurate mapping and elevation reference markers are vital to regulating new construction in floodplains.
Office of the Adjutant General Emergency Management Division	*Hazard Mitigation Grant Program*	X		X	This program provides funding for mitigation initiatives following a Presidential disaster declaration.
	Public Assistance Program		X	X	This program, available after a Presidential disaster declaration, allows mitigation measures to be incorporated into the repair of public facilities following a disaster.
	Pre-Disaster Mitigation Program	X		X	This annual, nationally competitive program funds mitigation plans and projects to reduce or eliminate the effects of future disasters. **Funding is dependent on Congressional appropriations.*
	Hurricane Program		X		The hurricane program coordinates efforts to prepare for and respond to hurricanes, and supports mitigation through public education and studies.
	Earthquake Program		X		The earthquake program provides coordination of seismic safety programs and supports mitigation through public education and promoting tools to support seismic hazard reduction.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
Governor's Office	Executive Order 99-11		X		This executive order established the Interagency Coordinating Committee (ICC) and mandated it be responsible for developing and maintaining the State Hazard Mitigation Plan.
Department of Archives and History	National Historic Preservation Act		X		Review of properties involved in mitigation projects for adverse effects to historical properties. The Department must approve the modification (including retrofitting for mitigation purposes) of historical properties.
Department of Commerce	Community Development Block Grant (CDBG)		X	X	The CDBG Program assists communities in providing decent housing, a suitable living environment, and expanded economic opportunities. CDBG funds can be used for mitigation projects.
Department of Education	Office of School Facilities		X		The Office of School Facilities (OSF) serves as the Building Official for public school facilities in South Carolina. The office regulates school construction in the floodplain, ensures schools meet building codes, and provides technical assistance in evaluating school sites and facility conditions, and funds school construction projects.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
Department of Health and Environmental Control Office of Ocean and Coastal Resource Management (OCRM)	Federal Coastal Zone Management Act, as amended (PL 104-150) and SC Coastal Zone Management Act, as amended	X			These acts require permits for activities in the designated coastal zone of the state, including, but not limited to, stormwater management and beachfront development. DHEC-OCRM also reviews proposed federal permits in the coastal zone to ensure the activity is consistent with the state coastal zone management policies.
	Beach Restoration Fund	X		X	This program provides funding for beach nourishments projects.
Department of Health and Environmental Control Bureau of Water	SC Stormwater Management and Sediment Reduction Act of 1991		X		This act requires permits to ensure development does not create substantial amounts of stormwater runoff or sediment buildup.
	SC Erosion and Sediment Act of 1983		X		This act requires permits to ensure development minimizes erosion soil and sedimentation of streams.
Department of Insurance	SC Safe Homes		X	X	The South Carolina Hurricane Damage Mitigation Program, also known as the SC Safe Home Grant Program, offers grants for South Carolinians to strengthen their homes against the damaging effects of high winds from hurricanes and severe storms.
Department of Labor, Licensing, and Regulation (LLR)	Manufactured Housing Board		X		The board sets regulations for the installment of manufactured homes in the state. Proper installation of manufactured housing provides enhanced protection against hazards such as floods, earthquakes, and hurricanes.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	Office of State Fire Marshal		X		Deputy fire marshals conduct fire safety inspections to ensure compliance with fire safety codes. Enforcement of fire safety codes increases protection to structures from fire, thereby reducing property damage and loss of life.
Department of Labor, Licensing, and Regulation (LLR) Building Codes Council	Building Codes Program		X		The program assures uniformity in the use, adoption and interpretation of building codes on a statewide basis.
	Modular Building Program		X		The program ensures that the construction of modular buildings conforms to established building codes for site constructed buildings and meets the regional requirements for resistance to earthquakes, and hurricanes.
Department of Natural Resources (DNR)	Biggert-Waters Flood Insurance Reform Act of 2012	X		X	The Biggert-Waters Flood Insurance Reform Act of 2012 merged the Repetitive Flood Claims (RFC) Program and the Severe Repetitive Loss (SRL) Program with the Flood Mitigation Assistance (FMA) Program. FMA provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program (NFIP).

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	National Flood Insurance Program (NFIP)	X			SCDNR administers the NFIP in South Carolina. They assist local governments in developing and administering floodplain ordinances and provide technical assistance on flood insurance issues. SCDNR also provides technical assistance to communities in developing flood mitigation plans.
	Risk Map	X			SCDNR implemented the Map Modernization Initiative to begin a complete update of flood maps in the state and produce them in a digital format. The Map Modernization program has morphed into the RiskMAP initiative with FEMA. This program continues to update and digitize the flood insurance rate maps, as well as aid in the development of non-regulatory products that help communicate risk to homeowners in South Carolina. The goal is to have all flood maps updated within five years.
	South Carolina Drought Response Act		X		This act established procedures by which the state's water resources could be monitored, managed, and conserved in the best interest of South Carolinians during periods of drought. DNR serves as the primary agency to monitor drought conditions, or potential for drought, throughout the state and to coordinate the state's response.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	Geologic Survey		X		The mission of the Geological Survey is to provide a service-oriented research program, which collects, studies, interprets, and reports all information pertaining to geology affecting the daily lives of the citizens of this state. A goal of this program is the dissemination of geologic information, which can be used for better land use planning, economic development, emergency preparedness and education.
Department of Transportation	Division of Engineering		X		The division ensures that roads and bridges are engineered and designed to state and federal regulations. They also conduct flood and earthquake studies and bridge design in cooperation with communities. The results of these studies can be used in floodplain regulatory programs.
Forestry Commission	Firewise	X			The Commission promotes the Firewise program in South Carolina and encourages communities to join the program.
	Prescribed Burning Assistance	X			The Commission provides assistance to landowners on development of a prescribed burning plan, constructing firebreaks, or conducting the actual prescribed burns.
	Forest Stewardship Program	X		X	This program assists landowners in development of a Stewardship Management Plan that helps to reduce wildfire and erosion risks. Funding is available to implement plans once they are approved.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	Prescribed Burning Assistance	X			The Commission provides assistance to landowners on development of a prescribed burning plan, constructing firebreaks, or conducting the actual prescribed burns.
	Wildfire Detection	X			The Forestry Commission provides aerial detection via the use of federal excess aircraft to locate wildfires for quick response to minimize loss to life, property and our natural resources.
	Wildfire Prevention		X		The Commission has trained personnel in the area of wildfire education prevention techniques and implements those ideas through statewide or community wide efforts.
	Wildfire Prevention-Law Enforcement		X		The Commission informs and enforces all outdoor burning laws related to forestry, wildlife, and agriculture to ensure that fire is used safely and properly.
	Wildfire Suppression	X			The Forestry Commission provides wildfire suppression equipment to fight wildfires on all lands outside incorporated areas and assists federal agencies with wildfire suppression on their lands.
	Forest Stewardship Program	X		X	This program assists landowners in development of a Stewardship Management Plan that helps to reduce wildfire and erosion risks. Funding is available to implement plans once they are approved.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
	Forest Health	X		X	This program assists landowners by monitoring insect and disease outbreaks and storm damage and providing those affected with forest management recommendations to reduce the resultant increasing wildfire hazard due to the accumulation of dead fuels.
University of South Carolina	Hazard & Vulnerability Research Institute (HVRI)		X		HVRI developed and maintains the State of South Carolina Hazards Assessment, which describes the hazards that affect the state. HVIR also compiled a GIS-based database of hazards data and made it available through an internet site that was instrumental in developing state and local hazard mitigation plans.
	Earth Sciences and Resources Institute		X		The Institute conducts studies of hazard events such as earthquakes, floods, and erosion, and hosts a web site with relevant information for public information.
	Department of Civil Engineering		X		The research conducted by this department has spawned the development and testing of products for retrofitting buildings and infrastructure for enhanced earthquake resistance.
The Citadel	Department of Civil Engineering		X		This department has conducted research on earthquake-related codes and standards. This department also participates in traffic studies with the S.C. DOT to determine where road improvements may be needed to enhance emergency evacuation of residents.

AGENCY	RELEVANT PLANS, POLICIES, PROGRAMS AND/OR GRANTS	EFFECTS ON LOSS REDUCTION		PROGRAM PROVIDES FUNDING	DESCRIPTION
		SUPPORT	FACILITATE		
College of Charleston Department of Geology and Environmental Geosciences	Santee Cooper GIS Laboratory		X		This Department coordinates the Santee Cooper GIS Laboratory, which is planned to be utilized for training local and state government personnel on the HAZUS-MH software packages for estimating damages associated with hazard events. This department also develops educational materials for the general public on earthquake hazard mitigation and monitors earthquake activity.
Clemson University Department of Civil Engineering	Wind Load Testing Facility		X		The Wind Load Test Facility houses one of the largest boundary-layer wind tunnels in the nation. The research performed there helps to understand wind fields within hurricanes and their affect on structures. The department performed experiments on homes in Horry County after Hurricane Floyd to determine their ability to withstand hurricane force winds.
South Carolina Sea Grant Consortium	113 Calhoun Street		X		The 113 Calhoun Street project provides a laboratory, demonstration site, and classroom for hazard resistant building materials and techniques developed by public and private research institutions.
South Carolina Association for Hazard Mitigation (SCAHM)	SCAHM Annual Conference and Roundtable Meetings		X		The Association serves as a state chapter of the Association of State Flood Plain Managers. SCAHM hosts an annual conference as well as periodic roundtable meetings to discuss hazard mitigation issues.

Program Integration

This plan serves as a coordinating mechanism to incorporate or enhance mitigation within existing state programs. Specific examples include:

1. Land Use Planning
2. Floodplain Management
3. Coastal Zone Management and
4. Comprehensive Planning

The examples above were generated using the results of an internal review of plans, policies and programs related to hazard mitigation. An evaluation of the policies, programs, and capabilities that allow the state to mitigate against flood prone repetitive loss properties was completed. The findings are summarized across the following capabilities:

1. Administrative Capability
2. Technical Capability
3. Fiscal Capability
4. Legal Capability
5. Political Willpower

B. ADMINISTRATIVE CAPABILITY

The state has a limited level of administrative capability to carry out hazard mitigation policies and projects due to the natural hazard vulnerabilities. The state is taking steps to improve over time as shown herein (see Tables 6.1 and 6.2). Examples include: 1) the goals developed addressing enhanced legislation and codes, 2) improved interagency coordination, 3) the identification and implementation of specific mitigation projects, 4) the improved use of existing resources and data and 5) improving outreach and training. Capabilities were evaluated by reviewing state staffing and the organizational structure across state government. Since the primary responsibility to coordinate statewide mitigation efforts falls with SCEMD and SCDNR, an emphasis was placed on the review of the capabilities of these agencies. The other ICC Member roles, SCDOI and SCDHEC, are also included below.

As of January 2012 SCEMD has two staff members devoted to undertaking mitigation-related duties. The State Hazard Mitigation Officer (SHMO) oversees and manages the Mitigation Department for SCEMD. The grant programs include: the Hazard Mitigation Grant Program (HMGP) and the Pre-Disaster Mitigation (PDM) Program (depending on federal budgets). The SHMO coordinates statewide hazard mitigation activities with technical support from state agencies through the Interagency Coordinating Committee (ICC). The SHMO is tasked with the oversight of the development of this plan and the county-level mitigation plans.

The South Carolina Department of Natural Resources (DNR) is responsible for the application, award, grant management, and closeout of the Flood Mitigation Assistance grant program. This grant program offers federal mitigation assistance through the Federal Emergency Management

Agency (FEMA) to update the flood mitigation portion of Hazard Mitigation plans and projects to protect against flooding. Also, the SCDNR is the agency that contains the National Flood Insurance Program (NFIP) State Coordinating Office and is a Cooperating Technical Partner (CTP) in FEMA's flood hazard mapping program. The NFIP State Coordinating Office provides a vital link between the Federal government and local communities on matters related to floodplain management. Under the CTP agreement the SCDNR collaborates with local communities and FEMA in creating and maintaining up-to-date flood hazard maps and other flood hazard information.

The South Carolina Department of Insurance established the mitigation grant program, SC Safe Home following the passage of The Omnibus Coastal Property Insurance Reform Act of 2007. The program was one of several incentives included in the law that were designed to help lower coastal property insurance costs thereby making more attractive risks for insurers, all in an effort to minimize the impact the coastal regions of the state would experience from a hurricane or severe wind event. The grant program provides homeowners in the coastal communities up to $5,000 in one-time grant funds to assist them in mitigating their property and making it stronger against winds and the effects of hurricanes and natural disasters. To date, the program has awarded more than 2,000 grants totaling more than $8.5 million to coastal residents. Additionally, the program provides an economic impact to the coastal counties by working with more than 150 contractors and inspectors that have received specialized training through the program to do the code-plus retrofit work to the homes.

The SC Safe Home Program continues to grow and receive national recognition, as it is the only program of its kind. SC Safe Home has been featured on webinars, websites and conferences for organizations including the The National Housing Policy Council, CERES, and The Heinz Foundation. The Department and SC Safe Home continue to receive recognition at state and national meetings hosted by organizations such as Ren Re, Weather Predict, The Travelers Institute, The Federal Alliance for Safe Homes, The Institute for Business and Home Safety and others.

The South Carolina Department of Health and Environmental Control (DHEC) is the environmental quality control and health regulation agency of the state. It is responsible for the implementation of state and federal regulations related to the protection of the environment and the health of its residents, including the regulation and oversight of licensed health care facilities. By the regulatory nature of this agency, SCDHEC conducts mitigation planning and activities by ensuring that facilities, businesses, and water and air quality businesses and agencies meet the minimum standards as established in regulations. Specifically, the dam infrastructure is monitored by SCDHEC staff and dam safety is an area of mitigation concern. The agency also implements surveillance measures to monitor, advise, and protect the public and healthcare providers in the case of bioterrorism or disease outbreaks.

SCDHEC's Office of Ocean and Coastal Resource Management (OCRM) is directed by the SC Coastal Zone Management Act (1977) "…to provide for the protection and enhancement of the State's coastal resources." A component of protecting the State's coastal resources is mitigating disasters. The Department promotes disaster mitigation through: 1) Critical Area permitting, 2) local beach management plans, and 3) renourishment funding assistance. First, OCRM administers a permitting program for the utilization of Critical Areas, which are defined as coastal waters, tidelands, beach/dune systems, and beaches. Construction or reconstruction seaward of the jurisdictional baseline or between the baseline and setback line is regulated, and there are limitations (i.e.: square footage of heated space; sited as far landward as possible) on development of property that falls between these lines. Retreat from the active beachfront is also encouraged, particularly post-disaster. Habitable structures are guided to be constructed or reconstructed as far landward as possible. New beachfront erosion control devices, such as seawalls, are prohibited and beachfront erosion control devices that are damaged beyond repair may not be reconstructed. Second, local comprehensive beach management plans are prepared by local governments with assistance from OCRM. The comprehensive plans include an inventory of erosion rates, structures within the Department's beachfront jurisdiction, public access points and facilities for each beachfront community. Moreover, the plans require the local government to have a post-disaster plan to promote preparedness. Lastly, state generated revenue is sometimes available for beach renourishment needs, but funding is contingent on local governments having updated comprehensive beach management plans, adequate public access and matching local funds.

In addition to the ICC and technical experts, SCEMD has the support of the numerous local, state and federal agencies to develop and implement the goals and mitigation actions found in this plan. Furthermore, SCEMD has an organizational structure that served as the foundation for the oversight of the planning process. These partners work closely with SCEMD and FEMA to ensure the plan's maintenance, track progress and update the plan as needed.

Improvements continue in the degree to which state agencies coordinate complimentary objectives addressing hazard mitigation activities. In addition, there has been improved coordination building on established relationships, conducting hazard studies across the state, and cultivating positive working relationships.

The Mitigation Action Plan, which forms the basis of Section 7 and Section 8, serves as a primary means to achieve an improved level of inter-agency coordination. By establishing clear actions, linked to specific agencies, accountability is increased. Actions are assigned timelines approved by the ICC, further linking policy and project completion with accountability. Therefore actions can be tracked over time to assess the degree to which the plan is achieving desired aims. Finally, the Mitigation Action Plan is easily updated as needed, following a disaster or as required by the Stafford Act, thereby increasing the likelihood that state agencies remain involved.

Floodplain Management

Sound floodplain management involves a series of programs designed to reduce flood-related damages. Programs such as the National Flood Insurance Program (NFIP), the Community Rating System (CRS) and the Flood Mitigation Assistance (FMA) program provide the framework to implement a successful floodplain management program. The NFIP contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to flood hazards. In order for a county or municipality to join the NFIP, they must adopt a Local Flood

Damage Prevention Ordinance. This document provides local governments with a powerful regulatory tool to reduce future flood-related losses. Another key service provided by the NFIP includes the mapping of identified flood hazard areas. Flood Insurance Rate Maps and studies are used to assess flood hazard risk and set flood insurance rates. The maps also provide an important means to educate residents, government officials and the business community about the likelihood of flooding in their community.[6]

C. TECHNICAL CAPABILITY

The state has a moderate level of technical capability to implement the state hazard mitigation strategy. While there exists a wide range of technical resources across state agencies, the development of a systematic protocol for sharing resources to analyze natural hazards and develop meaningful actions to reduce their impact could be improved. Additional factors affecting technical capability include:

1. Information on past disasters and mitigation projects;
2. Experience in disaster management and mitigation planning; and
3. The application of technology to address hazards. Examples include the use of GIS-driven risk assessments and information technologies to facilitate the formulation, development, implementation, and monitoring of mitigation actions.

Technical capability can be defined as possessing the skills and tools needed to accomplish specific tasks and distribute the results to those associated with the State of South Carolina Hazard Mitigation Program. Technical capability can be measured across three primary elements: 1) geographic information systems (GIS) and database management; 2) grants management; and 3) hazard mitigation planning. Measuring the degree to which each element is found in the state was conducted through interviews with state staff.

Geographic information systems (GIS) and database management capabilities can be measured by reviewing existing tools (hardware and software) and the access to individual experts who can effectively gather, analyze and display relevant information. In the case of South Carolina, SCEMD developed the data analyses needed for the hazards.

The Hazard Vulnerability Research Institute (HVRI) within the University of South Carolina (USC) conducts field and survey research on group, organizational, and community preparation for, response to, and recovery from natural and technological disasters and other community-wide crises. The HVRI, in conjunction with SCEMD, has compiled hazard and loss data for the entire state and made it available on the Internet in GIS format. This data is used to conduct risk assessments for this plan as well as local hazard mitigation plans. The USC Geology Department has conducted numerous earthquake-related studies in South Carolina, including on-going analysis of earthquake vulnerability in the Charleston-Berkeley-Dorchester county area.

The information generated and analyzed has proven valuable to assist in the identification of hazard vulnerability, assess past events and document specific mitigation measures adopted across the state.

Hazard mitigation-related grants management capabilities were measured by assessing the State HMGP Administrative Plan, the number of staff assigned to conduct identified duties, and the degree to which state and FEMA mitigation staff should train local governments to implement mitigation grant programs. Adequate staff support and training were reviewed in the context of the overall vulnerability of the state to hazards, which took into account the size of the state and the number and magnitude of past events. In the state, hazard mitigation grants management duties are the responsibility of the SHMO and the State NFIP Coordinator who administer the Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation (PDM) Program and the Flood Mitigation Assistance (FMA) program, respectively. FEMA Region IV provides technical support as needed. Structured and regular training of local governments to administer grant programs continues to impact the statewide mitigation strategy. This training should allow for a source of expertise and staffing at the county and municipal level.

Hazard mitigation planning capabilities are the responsibility of the Mitigation Section within SCEMD and the State Flood Mitigation Program with SCDNR. The SHMO also relies on the ICC to assist in the multi-agency implementation of this plan.

D. FISCAL CAPABILITY

The ability to take action in a state is closely associated with the amount of money available to implement policies and projects. Funding may be obtained from grants or state and locally based revenue. The costs associated with policy and project implementation vary widely. In some cases, policies are tied to staff costs associated with the creation and monitoring of a given program. In other cases, funding is linked to a project, like the acquisition of flood-prone homes that can require a substantial commitment from local, state and federal funding sources. In either case, decisions must be made concerning how the state can reduce vulnerability to an acceptable level considering the availability of existing and future finances.

Taking into account both state agency operating budgets tied to mitigation-related activities and external funding sources obtained in recent years, the state has a limited fiscal capability for South Carolina's size and hazard vulnerability. Fiscal capability can be increased over time as a more direct link is made between existing state-level environmental and economic development programs and hazard mitigation objectives identified in this plan. Specific examples include the use of existing state and non-profit environmental land acquisition programs and the Community Development Block Grant (CDBG) program to address mitigation-related projects. The identification of eligible Pre-Disaster Mitigation projects, as well as other federal funding sources identified in this plan, should allow communities in the state to compete nationally for available funding and serve to highlight opportunities for state agencies to coordinate funding resources.

E. LEGAL CAPABILITY

In 1975, the General Assembly passed the Local Government Act, commonly called the Home Rule act, which gave counties authority to enact regulations and ordinances and make decisions regarding taxation and spending. It is important to note that while the state may provide the authority of a local government to act, much of the specific mitigation projects implemented in any given state are often done at the municipal level. Yet broader policy objectives and programs often exist at the state and federal levels of government. Furthermore, federal and state funding often drive local project initiatives. Therefore, in order to be effective, this plan should recognize the local; state and federal legal framework surrounding hazard mitigation planning.

In general, local governments have the authority to enact the following actions: regulation (including general police power, building codes and building inspections, land use), acquisition of property for public use, taxation and spending. Each of these categories provides tools that local governments can use to implement hazard mitigation measures.

<u>Police Power:</u> Local governments have the authority to enact hazard mitigation measures, based on their authority to protect public health, safety and welfare. One means to do this is using local ordinances. In addition, local governments can cite their authority to address "nuisances," which may include, under certain circumstances, those actions that make people or property more vulnerable to hazards.

<u>Building Codes</u>: Building codes represent a regulatory tool that can is used to reduce the impacts of hazards. Local governments in the state have the authority to enforce building codes adopted by the state and to adopt local flood damage prevention ordinances. The state has a standard minimum building and related codes for plumbing, mechanical, gas, and electrical installations that local governments are required to enforce.

<u>Land Acquisition</u>: Land acquisition can be a useful tool for pursuing mitigation goals. The acquisition of land represents a permanent means to reduce the impacts of geographically defined hazards. Governments may find the most effective method for completely "hazard-proofing" a particular piece of property or area is to gain the property (either in fee or an easement), thus removing the property from the private market. Examples include coastal property and wetlands.

ENABLING LEGISLATION, RULES AND EXECUTIVE ORDERS

The State of South Carolina and the Federal government maintain several relevant forms of enabling legislation, rules and executive orders that are directly relevant to hazard mitigation planning:

- Federal-State Agreement (The agreement is executed between the Governor and FEMA Regional Director following a disaster in order to receive federal assistance);
- The Robert T. Stafford Act of 1988 (PL 93-288), as amended;
- Title 44, Code of Federal Regulations;
- President's Executive Order 11988, Floodplain Management;
- President's Executive Order 11990, Protection of Wetlands;
- Flood Control Act of 1950, Section 215, PL 81-516 (33 USC 4001, et. seq.);
- National Flood Insurance Act of 1968, as amended (42 USC 4001, et. seq.);
- National Flood Insurance Reform Act of 1994 (established the Flood Mitigation Assistance (FMA) program.)
- Bunning-Bereuter-Blumenaur National Flood Insurance Reform Act of 2004 (repetitive flood loss provisions)
- Biggert-Waters Flood Insurance Reform Act of 2012
- Coastal Zone Management Act of 1972, as amended by PL104-150, The Coastal Zone Protection Act of 1996;
- SC Coastal Zone Management Act of 1976, as amended (Title 48, Chapter 39 of the South Carolina Code of Laws;
- Governor's Executive Order 99-11, Establishment of Interagency Coordinating Committee
- Regulation 58-1, Local Emergency Preparedness Standards, SC Code of Regulations;
- Regulation 58-101, State Emergency Preparedness Standards, SC Code of Regulations; and
- South Carolina Local Government Comprehensive Planning Enabling Act of 1994 (Title 6, Chapter 9 of the South Carolina Code of Laws

Political Willpower

One of the most difficult and sensitive capabilities to evaluate involves the political will of a state to enact meaningful policies and projects designed to reduce the impact of hazards. A variety of qualitative information was gathered to assist in this evaluation, including a review of current practices, programs and policies, the use of survey results, and conversations with state staff. Following an analysis of this information it was determined that the state has a moderate level of political will to enact meaningful and proactive mitigation policies. SCEMD and members of the ICC are knowledgeable about the potential hazards the state faces, and have become more familiar with the practices and principles of mitigation, particularly considering recent disasters. The current political climate at the state-level is favorable for supporting and advancing both existing and future hazard mitigation measures. Due to recent disasters there is a greater awareness of hazards, causing government officials to seek ways to reduce the impact of future events.

Completed hazard mitigation projects show an understanding of hazard mitigation, including the political will necessary to carry them out. Local governments should evaluate their effectiveness following events. The results should be presented to elected officials in order to provide examples of how mitigation can protect the lives and property of citizens. This can provide political support to improve the state's mitigation program.

F. STATE HAZARD MANAGEMENT CAPABILITIES

As part of the plan update process, SCEMD and the ICC have highlighted the following hazard management capabilities of the State:

1. As of May 2012, 219 communities in the State participate in the Federal Emergency Management Agency's National Flood Insurance Program (NFIP). Of these communities 41 (or 19%) participate in the Community Rating System (CRS).

2. Coordination with the USC Hazards & Vulnerability Research Institute continues. The Institute continues to provide a valuable resource to SCEMD with the update of the State Hazard Risk Assessment (last completed in 2009), as well as other technical assistance.

G. LOCAL CAPABILITY ASSESSMENT

Requirement 44 CFR §201.4(c)(3) (ii): *The mitigation strategy shall include a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities.*

Members of the ICC/SCEMD have been encouraging local governments to identify those actions most effective for hazard mitigation planning. The state provides guidance to the local governments and communities by providing model ordinances and sample plans. SCEMD has also been actively working with local governments throughout the state to generate interest and develop initiatives for hazard mitigation. The focus of this initiative is to generate interest at the local level and create advocates for the program. This work has taken place through the following forum: SCEMD mitigation staff schedule and conduct mitigation workshops to educate local emergency managers on the various mitigation programs and initiatives that are available and the benefits of those programs. These workshops provide an opportunity for an exchange of ideas and the development of mitigation initiatives based on the evaluation of state and local needs. Additionally, it helps generate interest in the mitigation program from the ground up. The state has also identified funding through federal programs such as HMGP and PDM for interested communities to adopt hazard mitigation plans and actions. SCEMD's knowledge of and ability to analyze local policies, programs and capabilities will continue to improve through the local mitigation plans currently being developed. SCEMD will incorporate that improved knowledge and analysis in future updates of the State Hazard Mitigation Plan as local plans are approved.

Table 6.2 provides a listing of local policies and programs, a brief description of those policies and programs, a discussion of their applicability and their effectiveness. These policies and programs help the state to mitigate against hazards and flood prone repetitive loss properties.

TABLE 6.2—LOCAL PLANS, POLICIES, PROGRAMS AND GRANTS IMPACTING HAZARD MITIGATION IN SOUTH CAROLINA

POLICY	DESCRIPTION	APPLICABILITY	EFFECTIVENESS
South Carolina Local Government Comprehensive Planning Enabling Act	This Act gave local governments the authority to adopt and update comprehensive plans.	Adoption of comprehensive plans gives a community the authority to enact zoning and land use ordinances.	Counties and municipalities will attempt to identify innovative ways to use existing planning requirements to reduce future disaster losses and mitigate against flood prone repetitive loss properties.
Building Codes	The State has adopted and local governments are required to adopt and enforce these codes.	Building codes address acceptable design standards. Building codes are regulations developed by recognized agencies establishing minimum building requirements for safety such as structural requirements for wind, earthquake, flood, and fire protection.	The Building Code Council updated the mandatory and permissive building codes to reflect the new 2012 International Code series, which went into effect July 1, 2013. Therefore all buildings built here after will comply with the new code, thus improving these structures substantially in the wake of various hazards.
Building Code Effectiveness Grading Scale	The Building Code Effectiveness Grading Schedule (BCEGS), administered by ISO, assesses the ability of the local governments to enforce building codes.	The program promotes adoption and enforcement of building codes in order to sustain fewer losses from natural hazards. ISO rates communities from 1 to 10, with 1 being the highest rating. The closer the BCEGS rating for a	BCEGS ratings for South Carolina *(see figure 6.1)*

POLICY	DESCRIPTION	APPLICABILITY	EFFECTIVENESS
		community gets to 1, the better insurance rates they may receive.	
Community Rating System	The primary goals of the CRS are to reduce flood losses, facilitate accurate insurance ratings, and promote the awareness of flood insurance. CRS is an incentive-based program that encourages local communities to accept defined actions designed to reduce the impacts of future flooding. Class ratings, which run from 1 to 10, are tied to flood insurance premium reductions.	CRS encourages communities to adopt regulations stricter than the minimal requirements of NFIP. Each of the 18 activities, or measures, is assigned points. As points are accumulated and reach identified thresholds, communities can apply for a reduced CRS class. Therefore, as class ratings get closer to 1, the percent reduction in flood insurance policies held in that community increases. *(see table 6.2)*	In the State of South Carolina, there are 32 communities in the CRS. *(see table 6.3)*
Contractor and Design Professional Licensing	Department of Labor, Licensing and Regulation licenses contractors (general and residential) and design professionals (architects, engineers, land surveyors) who practice in South Carolina.	Qualification examinations are administered to those seeking permission to practice in these professions.	Enforcement procedures are in place for those who violate applicable codes or standards and do not adequately correct the violations, resulting in safer structures.
Mutual Aid Agreements and Volunteer Services	Many local governments have entered into mutual aid	Through the mutual aid agreements, fire	Department of Natural Resources, Fish and Wildlife Department also has a

POLICY	DESCRIPTION	APPLICABILITY	EFFECTIVENESS
	agreements, whereby resource sharing will occur, if needed, in emergency situations.	suppression, building inspection, and other essential services are able to be performed when service demands exceed capabilities of the local governments, such as post-disaster.	cadre of local volunteers who assist them with their enforcement of applicable wildlife preservation laws and regulations when their staff levels are unable to meet demands. These resources are also available, if needed, for hazard mitigation activities or post-event.
EMAC, the Emergency Management Assistance Compact	Congressionally ratified organization that provides form and structure to interstate mutual aid.	Through EMAC, a disaster impacted state can request and receive assistance from other member states quickly and efficiently, resolving two key issues upfront: liability and reimbursement	In the event of a disaster South Carolina will benefit from the aid of other states to meet unmet needs.
StormReady	StormReady is a program established by the National Weather Service (NWS) to help communities better prepare for severe weather events. NWS works in conjunction with SCEMD to implement the program. Benefits of the program include being better prepared for severe weather events, which could lead to fewer casualties, as well as the community receiving credit	In order for a community to be considered a "Storm Ready Community," it must meet several criteria. The criteria includes 1) having a severe weather annex within the County EOP or other response plan, 2) having numerous ways in which to receive and disseminate weather and flood warnings, 3) having a team of trained storm	The program is continually looking to add more communities to the list of ones that have already met the criteria. SCEMD maintains a member on the StormReady Advisory Board, and participates in approving communities' applications and conducting site reviews to ensure compliance with the program. All 46 counties have been accredited and 8 municipalities. *(see figure 6.2)*

POLICY	DESCRIPTION	APPLICABILITY	EFFECTIVENESS
	under the Community Rating System (CRS) to help lower flood insurance premiums.	spotters within the community, and 4) taking part in weather-related public education seminars and exercises, including the statewide tornado drill for public schools. The program also requires participants to have NOAA weather radios located within all public buildings.	
TsunamiReady	The TsunamiReady Program, developed by the National Weather Service, is designed to help cities, towns, counties, universities and other large sites in coastal areas reduce the potential for disastrous tsunami-related consequences.	TsunamiReady helps community leaders and emergency managers strengthen their local operations. TsunamiReady communities are better prepared to save lives through better planning, education and awareness.	Communities have fewer fatalities and property damage if they plan before a tsunami arrives. No community is tsunami proof, but TsunamiReady can help minimize loss to your community. Currently, 3 counties and 4 municipalities are TsunamiReady.
Land Use Planning	Comprehensive land use planning provides a mechanism to prevent development in hazardous areas or allows development in a manner that minimizes damage from hazards. Land use planning gives local governments "the big picture	Local governments use land use planning to identify those areas subject to damage from hazards and work to keep inappropriate development out of these areas.	New development can be minimized in identified hazard areas. Counties and cities are starting to work together in some areas to coordinate land use issues so that one jurisdiction does not adversely affect the other.

POLICY	DESCRIPTION	APPLICABILITY	EFFECTIVENESS
	of what is happening in their jurisdiction.		
Zoning	Zoning is a legal tool that municipal governments use to control the use of buildings and land within the municipality.	When used effectively, zoning can be used to limit development in hazard areas.	Local governments continue to monitor and update as needed. It is now reviewed and coordinated through SC Recovery Plan Appendix 6 Attachment I.
National Flood Insurance Program (NFIP)	The NFIP contains specific regulatory measures that enable government officials to determine where and how growth occurs relative to flood hazards. In order for a county or municipality to join the NFIP, they must adopt a Local Flood Damage Prevention Ordinance.	Ideally, enforcing the regulations of the NFIP will cause new development in a community to not be at risk to flooding. This is done through the requirements found in local flood ordinances and Flood Insurance Rate Maps (FIRMs).	The standards of the NFIP are estimated to save more than $1 billion in flood damage nationwide per year.
Section 48-39-350 of the Coastal Zone Management Act	This act requires permits for activities in the designated coastal zone of the state, including, but not limited to, stormwater management and beachfront development.	OCRM also reviews proposed federal permits in the coastal zone to ensure the activity is consistent with the state coastal zone management policies.	OCRM continues to mange this program.
Community Development Block Grant Program	The CDBG Program assists communities in providing decent housing, a suitable living environment, and expanded economic opportunities.	CDBG funds can be used for mitigation projects.	It is now coordinated through SC Recovery Plan Appendix 6 Attachment I.

POLICY	DESCRIPTION	APPLICABILITY	EFFECTIVENESS
Capital Improvement Planning	Identifies where major public expenditures will be made over the next 5 to 10 years.	Capital Improvement Plans secures hazard-prone areas for low risk uses, identify roads or utilities that need strengthening, replacement, or realignment, and can prescribe standards for the design and construction of new facilities.	More and more jurisdictions are taking cost-effective mitigation measures into consideration when developing capital improvement projects. Success stories continue to show that development, with associated mitigation measures, can take place with minimal natural hazard risk. The dissemination of these success stories will continue to strengthen the overall mitigation program at both the state and local levels.
Subdivision Regulations	Sets construction and location standards for subdivision layout and infrastructure.	Jurisdictions are starting to look at the impacts of existing and planned subdivision developments and methods to reduce and/or eliminate those impacts.	Combinations of storm water retention projects and locally funded buyouts are making a significant difference in new subdivisions.

Planning

The South Carolina Local Government Comprehensive Planning Enabling Act of 1994 gave local governments the authority to adopt and update comprehensive plans. These plans contain the planning process that examines an inventory of existing conditions, a statement of needs and goals, and implementation strategies with time frames. To accomplish this, the plan contains population, economic development, natural resources, cultural resources, community facilities, housing, and land use elements. Thus, comprehensive plans provide an important vehicle to address hazards. Adoption of comprehensive plans gives a community the authority to enact zoning and land use ordinances. An important addition to the plan includes the inclusion of mitigation-related activities into comprehensive plans. In addition, the plans state that counties and municipalities should try to identify innovative ways to use existing planning requirements to reduce future disaster losses.

Building Codes

Building codes are regulations developed by recognized agencies establishing minimum building requirements for safety such as structural requirements for wind, earthquake, flood, and fire protection. Building codes address acceptable design standards. The South Carolina Building Code Council reviews and adopts acceptable building codes.. In July 2013, the Building Code Council updated the mandatory and permissive building codes to reflect the new 2012 International Code series. The Building Codes Council registers all code enforcement officials in the state to verify the credentials of those performing these duties

Building Code Effectiveness Grading Schedule

The Building Code Effectiveness Grading Schedule (BCEGS), administered by ISO, assesses the ability of the local governments to enforce building codes. The program promotes the adoption and enforcement of building codes in order to sustain fewer losses from natural hazards. ISO rates communities from 1 to 10, with 1 being the highest rating. The closer the BCEGS rating for a community gets to 1, the better insurance rates they may receive. The ratings are divided into two categories, personal lines and commercial lines. The personal lines rating addresses building code adoption and enforcement for one and two-family dwellings. The “commercial lines” rating is for all other buildings. See **Figure 6.1** for a distribution of BCEGS ratings for South Carolina.

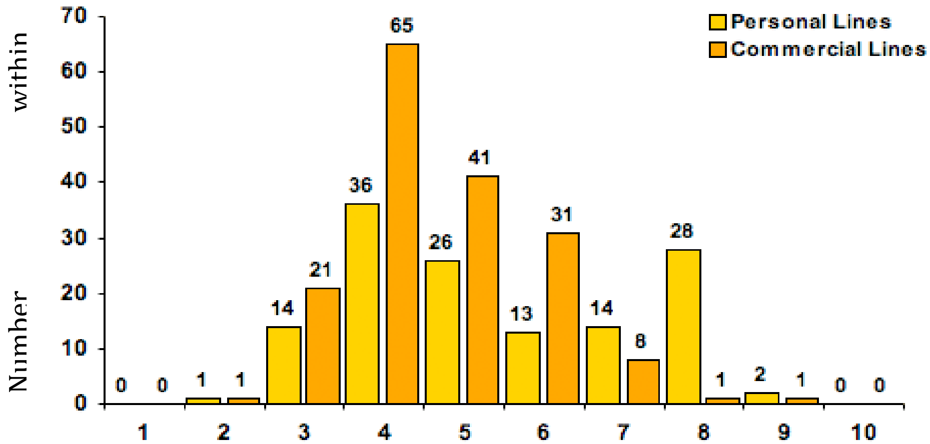


FIGURE 6.1—BCEGS RATINGS FOR SOUTH CAROLINA

The personal lines classification addresses building code adoption and enforcement for 1- and 2-family dwellings. The commercial lines classification is for all other buildings.

Community Rating System (CRS) Participation

The primary goals of the CRS are to reduce flood losses, facilitate accurate insurance ratings, and promote the awareness of flood insurance. The CRS achieves these goals by encouraging communities to adopt regulations stricter than the minimal requirements of the NFIP. The CRS is an incentive-based program that encourages counties and municipalities to accept defined actions designed to reduce the impacts of future flooding. Each of the 18 activities, or measures, is assigned points. As points are accumulated and reach identified thresholds, communities can apply for a reduced CRS class. Class ratings, which run from 1 to 10, are tied to flood insurance premium reductions. Therefore, as class ratings get closer to 1, the percent reduction in flood insurance policies held in that community increases (see **Table 6.3**).

TABLE 6.3—CRS PREMIUM DISCOUNTS

CRS CLASS	DISCOUNT
1	45%
2	40%
3	35%
4	30%
5	25%
6	20%
7	15%
8	10%
9	5%
10	---

In the State of South Carolina, there are 41 communities participating in the CRS. These communities are listed in **Table 6.4.**

TABLE 6.4—COMMUNITY RATING SYSTEM PARTICIPATION IN SOUTH CAROLINA

COMMUNITY	DATE OF ENTRY	CRS CLASSIFICATION
Aiken County	10/1/93	9
Awendaw, Town of	10/1/96	6
Beaufort County	10/1/91	7
Beaufort, City of	10/1/92	8
Berkeley County	5/1/08	9
Cayce, City of	5/1/10	9
Charleston County	10/1/95	4
Charleston, City of	10/1/93	7
Colleton County	5/1/05	7
Edisto Beach, Town of	10/1/92	8
Florence, City of	10/1/91	7
Florence County	5/1/10	9
Folly Beach, Township of	10/1/96	8
Georgetown, City of	10/1/93	8
Georgetown County	5/1/10	8

COMMUNITY	DATE OF ENTRY	CRS CLASSIFICATION
Greenville County	10/1/93	8
Greenville, City of	10/1/91	7
Hilton Head Island, Town of	10/1/91	5
Hollywood, Town of	10/1/10	6
Horry County	10/1/10	9
Isle of Palms, City of	10/1/94	7
Kiawah Island, Town of	10/1/96	6
Lexington County	10/1/91	8
McClellanville, Town of	10/1/00	6
Meggett, City of	10/1/96	6
Mount Pleasant, City of	10/1/94	6
Myrtle Beach, City of	10/1/91	5
North Charleston, City of	5/1/03	7
North Myrtle Beach, Town of	10/1/91	7
Pawley's Island, Town of	10/1/05	6
Pickens County	4/1/99	8
Port Royal, Town of	5/1/11	9
Ravenel, Town of	10/1/96	6
Richland County	10/1/95	8
Rockville, Town of	10/1/98	6
Seabrook Island, Town of	10/1/95	6
Sullivans Island, Town of	5/1/04	6
Sumter County	10/1/92	9
Sumter, City of	10/1/92	9
Surfside Beach, Town of	10/1/10	9
York County	10/1/09	9

Contractor and Design Professional Licensing

The Department of Labor, Licensing and Regulation (LLR) grants licenses to contractors (general and residential) and design professionals (architects, engineers, land surveyors) who practice in South Carolina. Qualification examinations are administered to those seeking permission to practice in these professions. Enforcement procedures are in place for those who violate applicable codes or standards and do not adequately correct the violations.

Mutual Aid Agreements and Volunteer Services

Many local governments have entered into mutual aid agreements, whereby resource sharing will occur, if needed, in emergency situations. Through the mutual aid agreements, fire suppression, building inspection, and other essential services are able to be performed when service demands exceed capabilities of the local governments, such as post-disaster.

The Department of Natural Resources Fish and Wildlife Department also has a cadre of local volunteers who assist them with their enforcement of applicable wildlife preservation laws and regulations when their staff levels are unable to meet demands. These resources are also available, if needed, for hazard mitigation activities or post-event.

Project Impact

Project Impact was a program under FEMA that preceded the Pre-Disaster Mitigation program. The purpose of the program was to identify communities as "Project Impact Communities" and provide them with funding to help set up mitigation programs. The five Project Impact communities in South Carolina are Orangeburg County, Charleston County, Georgetown County, Horry County, and the City of Florence. Each of the communities established public-private partnerships that led to successful mitigation programs.

StormReady®

StormReady is a program established by the National Weather Service (NWS) to help communities better prepare for severe weather events. The NWS works in conjunction with SCEMD to implement the program. In order for a community to be considered a "Storm Ready Community," it must meet several criteria. The criteria includes 1) having a severe weather annex within the County EOP or other response plan, 2) having numerous ways in which to receive and disseminate weather and flood warnings, 3) having a team of trained storm spotters within the community, and 4) taking part in weather-related public education seminars and exercises, including the statewide tornado drill for public schools. The program also requires participants to have NOAA weather radios located within all public buildings. The benefits of the program include being better prepared for severe weather events, which could lead to fewer casualties, as well as the community receiving credit under the Community Rating System (CRS) to help lower flood insurance premiums. The program is continually looking to add more communities to the list of ones that have already met the criteria. SCEMD maintains a member on the StormReady Advisory Board, and participates in approving communities' applications and conducting site reviews to ensure compliance with the program. The National Weather Service and SCEMD continue to encourage communities to participate in the program. **Figure 6.2** shows the communities approved in South Carolina in the StormReady program.

TsunamiReady™

The TsunamiReady Program, developed by the National Weather Service, is designed to help cities, towns, counties, universities and other large sites in coastal areas reduce the potential for disastrous tsunami-related consequences. Since June 20, 2001, TsunamiReady has helped community leaders and emergency managers strengthen their local operations. TsunamiReady communities are better prepared to save lives through better planning, education and awareness. Communities have fewer fatalities and property damage if they plan before a tsunami arrives. **Figure 6.2** shows the communities approved in South Carolina in the StormReady program.

To be recognized as TsunamiReady, here are some of the criteria that a community must meet:

- Establish a 24-hour warning point and emergency operations center
- Have more than one way to receive tsunami warnings and to alert the public
- Promote public readiness through community education and the distribution of information
- Develop a formal tsunami plan, which includes holding emergency exercises.

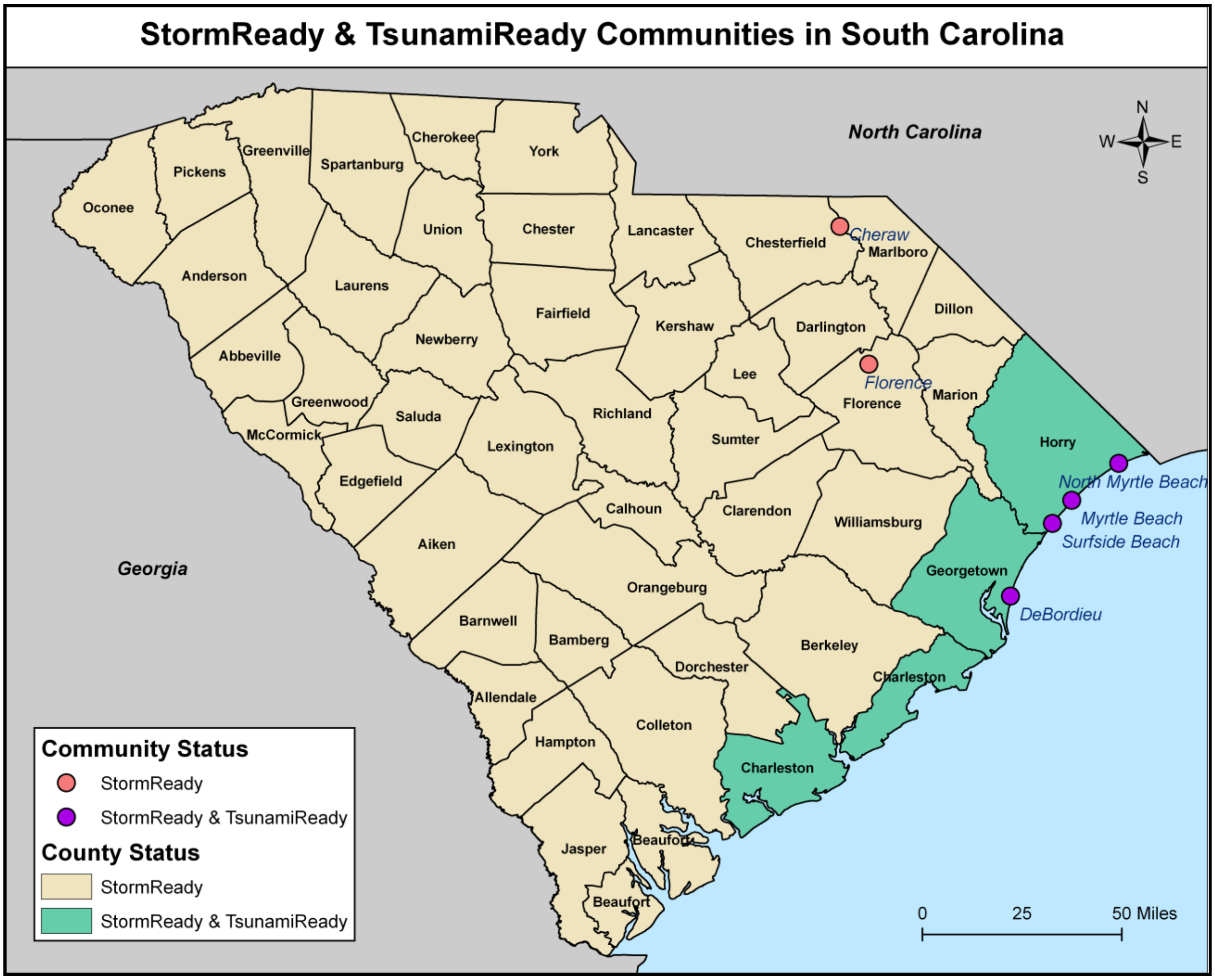


FIGURE 6.2—COMMUNITIES IN THE STORMREADY AND TSUNAMIREADY PROGRAM

H. CONCLUSIONS

The findings of the state *Capability Assessment* are intended to help SCEMD and the ICC meet the needs of county and local governments, while creating a state-level approach that is feasible given identified agency capabilities. In addition, the assessment is intended to identify potential agency partners who can assist in the development of a comprehensive mitigation strategy as well as identify areas in need of improvement. As noted in the introduction to this section, the capability assessment serves as part of the planning foundation, helping to craft a practical statewide mitigation strategy. As capabilities change, the assessment will change.

I. CHANGES FROM THE LAST PLAN

Because of FEMA requirements for plan updates, this section was reviewed and analyzed by the ICC as a result of the plan update completed in 2010. Changes were made to this section to bring it into compliance with the FEMA requirements. As part of the plan update process, the state took the opportunity to re-evaluate its pre- and post-disaster hazard mitigation programs, policies, and capabilities. This included conducting an assessment of hazard management capabilities of the state that have changed since the plan was last adopted. The state also conducted an assessment of its funding capabilities for hazard mitigation projects. The results of this re-evaluation have been incorporated into this section as necessary.

VII. MITIGATION STRATEGY

EMAP STANDARD
4.4.1: *The Emergency Management Program shall develop and implement its mitigation program to eliminate hazards or mitigate the effects of hazards that cannot be reasonably prevented. The mitigation program identifies ongoing opportunities and tracks repetitive loss. The Emergency Management Program implements mitigation projects according to a plan that sets priorities based upon loss reduction.*

A. INTRODUCTION

This section provides the State of South Carolina with the basis for action. Based on the findings of the Risk Assessment and the state-level Capability Assessment, the mission statement, goals, and actions that follow are intended to guide both the day-to-day operations and the long-term approach taken by the State of South Carolina to reduce the impacts of hazards. In order to achieve these aims, this section has been separated into the following components:

1. Goals, Objectives and Activities
2. Mitigation Goals
3. Identification and Analysis of Mitigation Measures
4. Identification of Mitigation Techniques
5. Mitigation Action Plan
6. Process Used to Evaluate and Prioritize Mitigation Actions
7. Cost Effectiveness of Mitigation Measures
8. Monitoring Implementation of Mitigation Measures and Project Closeouts
9. Funding Sources for Mitigation Actions
10. Monitoring Progress of Mitigation Actions

The plan is designed to be both comprehensive and strategic in nature. That is, the plan provides a comprehensive review of hazards and identify far-reaching policies and projects intended to not only reduce the future impacts of hazards, but also assist the State, counties and municipalities achieve compatible economic, environmental and social goals. In addition, the plan is strategic, in that all policies and projects are linked to departments or individuals responsible for their implementation. Funding sources are identified that can be used to implement identified actions.

The crucial basis for action in this plan can be found in the Mitigation Action Plan (MAP), which lists specific actions, those responsible for their implementation, potential funding sources that may be used, and an estimated target date for completion. Each action will be listed with this accompanying information. This approach provides those in charge of the plan's implementation with an important monitoring tool. The collection of actions also serves as an easily understood menu of policies and projects for decision makers.

B. MITIGATION GOALS, OBJECTIVES AND ACTIVITIES

Requirement 44 CFR §201.4(c)(3) (i): The mitigation strategy shall include a description of State goals to guide the selection of activities to mitigate and reduce potential losses.

EMAP STANDARD
4.4.2: *The mitigation program includes participation in applicable federal, state/territorial, tribal, local, and/or public/private mitigation efforts.*

The purpose of this section is to describe the general goals and objectives of the State mitigation program. In order to be effective, these goals and objectives must be achievable, while at the same time complimenting both the State and local mitigation strategy. Before adopting them, the State of South Carolina evaluated the goals, objectives and especially the mitigation measures (actions) using the Social, Technical, Administrative, Political, Legal, Economic and Environmental (STAPLEE) criterion. It is important that state and local government, public-private partnerships, and the average citizen can see the results of these mitigation efforts. By establishing achievable goals and objectives the various groups involved in the process can see that their efforts are making a difference and involvement in other mitigation efforts can be achieved.

As local plans are submitted for review and approval, the risk assessment outlined in this plan will be updated accordingly. As part of that process, the goals and objectives outlined in this plan will also be reviewed and updated as needed to reflect the current situation in the State. Every mitigation project that is considered for review and approval should, at the very minimum, have as its final result the potential to reduce the affects of a future disaster event.

Planning Approach

In order to guide the actions of those charged with implementation, the Plan follows a traditional planning approach. First, the goals are designed to meet the intent of the Plan. Next, mitigation actions are identified and tied to established goals. Actions may include policies or projects designed to reduce the impacts of future hazard events. Each step is intended to provide a clearly defined set of policies and projects based on a rational framework for action. The components of the planning framework are explained in greater detail below:

Goals: Goals represent broad statements that are achieved through the implementation of more specific, action-oriented policies or projects. Goals provide the framework for achieving the intent of the Plan.

Proposed Hazard Mitigation Policies: Policies are defined here as an ongoing course of action agreed to by members of the Planning Team. If appropriate, potential funding sources are listed.

Proposed Hazard Mitigation Projects: Projects are defined as discrete actions taken to address defined vulnerabilities to existing buildings or systems. Potential funding sources are listed for each project.

Mitigation Action Plan: The MAP is a prioritized list of actions (policies and projects), each of which includes a categorization of the mitigation technique, the hazards addressed, the individual or organization responsible for implementation, an estimated timeline for completion, and a series of potential funding sources.

C. MITIGATION GOALS

The following goals and mitigation actions (found in Section 8) a comprehensive approach taken by the State of South Carolina to reduce the impacts of natural hazards. Initial goals and actions were identified as part of a brainstorming session held July 28, 2004. Attendees of the brainstorming session included members of the Interagency Coordination Council (ICC) and invited stakeholders. On July 31, 2012, the ICC/SCEMD conducted a Mitigation Action Workshop for state agencies and non-profit organizations to discuss the updating of Action Items for the SHMP. Following the Workshop, all attendees were asked to report back to their respective agencies and identify additional actions that would be considered by SCEMD and the members of the ICC team.

As part of the plan update process conducted in 2011, the Interagency Coordination Council (ICC) reviewed the Mitigation Goals and each action identified in the Mitigation Action Plan. The committee conducted the review to ensure that, despite some slight modification to some of the wording, the goals remain valid and that the Mitigation Action Plan still reflects activities that will be implemented to achieve these goals. The ICC reviewed the risk assessment findings and updated and/or developed new mitigation goals and objectives for the plan. The risk assessment identified the following obstacles/gaps:

1. The state would benefit from incorporating more GIS and other technical information into the hazard mitigation planning process.
2. Many state residents did not realize hazard mitigation planning activities were occurring in the area.
3. Local communities in the state were unaware of the types of assistance available to them for hazard mitigation planning.

The purpose of this section is to describe the general goals and objectives of the South Carolina Mitigation Program.

Goal #1: Implement policies and projects designed to reduce or eliminate the impacts of hazards on people and property.

Goal #2: Obtain resources necessary to reduce the impact of hazards on people and property.

Goal #3: Enhance training, education, and outreach efforts focusing on the effects of hazards, importance of mitigation, and ways to increase resiliency.

Goal #4: Collect and utilize data, including conducting necessary studies and analyses, to improve policymaking and identify appropriate mitigation projects.

Goal #5: Improve interagency coordination and planning to reduce the impact of hazards on people and property.

Goal #6: Enhance compliance capabilities in order to reduce the impacts of hazards on people and property.

Goal #7: Enhance and encourage the use of natural resource protection measures as a means to reduce the impacts of hazards on people and property.

D. IDENTIFICATION AND ANALYSIS OF MITIGATION MEASURES

FEDERAL REQUIREMENTS FOR STATE MITIGATION PLANS
44 CFR 201.4(c)(3)(iii): *[State plans shall include] an identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and an explanation of how each activity contributes to the overall mitigation strategy. This section should be linked to local plans, where specific local actions and projects are identified.*

EMAP STANDARD
4.4.5: *The mitigation plan shall be based on the natural and human-caused hazards identified by the Emergency Management Program and the risk and consequences of those hazards. The mitigation plan for the jurisdiction is developed through formal planning processes involving Emergency Management Program stakeholders and shall establish interim and long-term strategies, goals, objectives, and actions to reduce risk to the hazards identified. The Emergency Management Program implements a process and documents project ranking based upon the greatest opportunity for loss reduction and documents how specific mitigation actions contribute to overall risk reduction.*

In formulating this Mitigation Strategy, a wide range of activities was considered in order to help achieve the goals of the Plan. All of the activities chosen by the ICC and participating stakeholders fall into one of the broad categories of mitigation techniques listed below. Each mitigation action contributes to the overall State Mitigation Strategy.

E. IDENTIFICATION OF MITIGATION TECHNIQUES

Prevention

Prevention activities are intended to keep hazard-related problems from getting worse. They are particularly effective in limiting a community's future vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Examples of prevention activities include:

1. Planning and zoning;
2. Hazard mapping;
3. Building codes;
4. Studies / data collection and analysis;
5. Open space preservation;
6. Floodplain regulations;
7. Stormwater management;
8. Drainage system maintenance;
9. Capital improvements programming; and
10. Riverine setbacks.

Property Protection

Property protection measures are intended to enable structures to better withstand hazard events, remove structures from hazardous locations, or provide insurance to cover potential losses. Examples include:

1. Acquisition;
2. Relocation;
3. Building elevation;
4. Critical facilities protection or "hardening";
5. Retrofitting (i.e., wind proofing, flood proofing, seismic design standards, etc.);
6. Insurance; and
7. Safe room construction.

Natural Resource Protection

Natural resource protection activities reduce the impact of hazards by preserving or restoring the function of environmental systems. In some cases, natural systems may include high hazard areas such as floodplains, steep sloped areas or barrier islands. Thus, natural resource protection measures can serve the dual purpose of protecting lives and property while enhancing environmental goals such as improved water quality or recreational opportunities. Parks, recreation or conservation agencies and organizations often implement natural resource protection measures. Examples include:

1. Floodplain protection;
2. Riparian buffers;
3. Fire resistant landscaping;
4. Best management practices
5. Fuel breaks;
6. Erosion and sediment control;
7. Wetland preservation and restoration;

8. Habitat preservation; and
9. Slope stabilization.

Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by physically modifying the environment. They are usually designed by engineers and managed or maintained by public works staff. Examples include:

1. Reservoirs;
2. Levees / dikes / floodwalls;
3. Diversions / Detention / Retention;
4. Beach nourishment;
5. Channel modification; and
6. Storm sewer construction.

Emergency Services

Although not typically considered a "mitigation technique," emergency services can significantly reduce injuries and loss of life associated with hazards. These actions are typically taken immediately prior to, during, or in response to a hazard event. Examples include:

1. Warning systems;
2. Search and rescue;
3. Evacuation planning and management; and
4. Flood "fighting" techniques.

Public Information and Awareness

Public Information and awareness activities are used to advise residents, business owners, potential property buyers, visitors and government officials about hazards, hazardous areas and mitigation techniques they can use to protect themselves and their property. Measures used to educate and inform the public include:

1. Outreach and education;
2. Speaker series, demonstration events;
3. Real estate disclosure; and
4. Training.

F. MITIGATION ACTION PLAN

FEDERAL REQUIREMENTS FOR STATE MITIGATION PLANS
44 CFR 201.4(c)(3)(iv): *[The State mitigation strategy shall include] the identification of current and potential sources of Federal, State, local, or private funding to implement mitigation activities.*

State of South Carolina Mitigation Actions

The mitigation actions identified by the State of South Carolina are listed in Section 10. Each has been designed to achieve the goals of the plan. The mitigation actions are short-term, specific measures to be undertaken by the members of the ICC and will be used as the primary measure of the plan's progress over time. This approach is intended to ease the implementation of the actions and facilitate the quick review and update of the plan as described in the *Plan Maintenance Procedures* section, Section 9. Mitigation actions included in this plan were evaluated and prioritized by mitigation planning committee members during the planning process.

Figure 7.1 and the discussion following provide a sample of the information collected in determining mitigation actions.

MITIGATION ACTION (Describe)	
A. Category	
B. Hazard(s) Addressed:	
C. Priority (High, Moderate, Low):	
D. Estimated Cost:	
E. Potential/Current Funding Sources:	
F. Lead Agency/Department Responsible:	
G. Implementation Schedule:	
H. Implementation Status	
I. Milestones Achieved/ Impediments to Implementation:	

FIGURE 7.1—MITIGATION ACTION WORKSHEET

1. Category: Mitigation actions fall within the following categories: prevention, property protection, natural resource protection, structural projects, emergency services and public information and awareness. The classification of actions allows those responsible for the Plan's development to assess whether they are pursuing a comprehensive mitigation strategy.
2. Hazard(s) Addressed: The hazard(s) the action is designed to mitigate.
3. Priority (High, Moderate, Low): Indicate whether the action is a 1) High priority – short-term immediate – reducing overall risk to life and property; 2) Moderate priority – an action that should be implemented in the near future due to political or community support or ease of implementation; 3) Low priority – an action that should be implemented over time, but does not have the same sense of urgency or impact on hazard vulnerability as other higher priority actions.
4. Estimated Cost: If applicable, indicate what the cost will be to accomplish the mitigation action. The amount should be estimated until a more accurate project cost can be determined.

5. Potential/Current Funding Sources: If applicable, indicate how the action will be funded. For example, funds may be provided from existing operating budgets (General Revenue), from a previously established contingency fund (Contingency/Bonds), or a federal or State grant (External Sources).
6. Lead Agency/Department Responsible: Identify the state agency, department or organization that is best suited to accomplish the mitigation action.
7. Schedule: Indicate when the action will begin and when the action is expected to be completed. Remember that some actions will require only a minimum amount of time, while others may require a long-term commitment.
8. Implementation Schedule: Provide an update as to the status of the implementation of the action. Common answers may be that the action has been completed, deleted, or deferred.
9. Milestones Achieved/Impediments to Implementation: Provide any information that gives details as to the success or difficulty experienced in implementing the action.

G. PROCESS USED TO EVALUATE AND PRIORITIZE GOALS AND MITIGATION ACTIONS

FEDERAL REQUIREMENTS FOR STATE MITIGATION PLANS
44 CFR 201.4(c)(5)(ii) and (iii): ***[The State plan maintenance process should include] 1) A system for monitoring implementation of mitigation measures and project closeouts. 2) A system for reviewing progress on achieving goals as well as activities and projects in the Mitigation Strategy.***

To ensure that South Carolina is meeting the goals as outlined in the mitigation strategy, it is necessary to review and evaluate progress on a routine basis. Annually, the ICC will discuss the mitigation goals to determine if the goals are still relevant, if progress has been achieved, and if the mitigation actions need to be changed to reflect this advancement. Progress is defined as development of our mitigation strategy and initiatives to reach the outlined goals. For instance, if SCEMD institutes an enhanced training and outreach program for community resiliency in the state, the ICC would note this achievement in the discussion as meeting Goal #3. In addition, as part of this process, the ICC may determine that a goal has been met and a new goal should be created in its place. All changes, improvements, and progress will be noted in the update of the next State Hazard Mitigation Plan.

As part of reaching state mitigation goals, mitigation actions must be developed and completed. Funding will always be an important issue when considering mitigation actions. State and federal mitigation funds are limited. Generally these funds are only available as the result of declared disasters. As such, a process has been developed to evaluate and prioritize proposed mitigation actions.

The ICC, with SCEMD as the lead agency, has the primary responsibility for reviewing and evaluating mitigation projects submitted by local jurisdictions. Local jurisdictions are strongly encouraged to incorporate mitigation initiatives, based on established natural hazard risk assessments, into all proposed development projects and as improvements to existing projects. To varying degrees this has been established as a part of project development and approval. The following issues will be reviewed and discussed as part of the process used to evaluate and prioritize mitigation projects:

1. The jurisdiction that submitted the mitigation proposal must have an approval local hazard mitigation plan on file. Jurisdictions with a population of less than 3,000 that do not have an approved hazard mitigation plan on file must have the capability and desire to complete a plan within twelve months of project approval.
2. The project must be in conformance with the jurisdiction's approved hazard mitigation plan. Since situations and priorities change over time, projects that are not in the jurisdictions mitigation plan may still be approved, if they meet all other mitigation project eligibility requirements.
3. The project must solve a problem independently or constitute a functional portion of a solution where there is assurance that the project as a whole will be completed.
4. The project must be cost-effective, environmentally sound, technically sound, and substantially reduce the risk of future damage, repetitive loss by flood, or suffering resulting from a major disaster.
5. The hazard being mitigated will be checked against the current risk assessment as outlined in the jurisdictions approved local hazard mitigation plan.
6. Funding will be open to all eligible entities within South Carolina; however, priority may be given to those projects located within the declared disaster area.
7. A review of mitigation efforts undertaken by the jurisdiction using local funds and initiatives.
8. A review of the disaster history of the jurisdiction including flood prone repetitive loss properties.
9. Availability of matching funds from the state and/or local jurisdiction.
10. Communities that are challenged by intense development pressures.

This plan does not differentiate or classify mitigation initiatives as primary or alternates. Mitigation initiatives will be evaluated and prioritized based on the criteria described above. Any mitigation project that is approved for funding is done so on the basis that it will benefit the community at large and therefore the State.

State of South Carolina project priorities consider hazards, risk, vulnerability and capabilities. In general prioritization considerations are given to communities that have the highest risk. Flood buyout projects (especially for repetitive loss properties), other flood mitigation and structural projects to permanently protect essential infrastructure are the State's highest priority. Projects to protect individuals from frequent hazards events such as tornadoes and high wind will rank second. This is followed by projects to reduce losses from low probability events, such as earthquakes.

H. POST-DISASTER IMPLEMENTATION

Following a presidential disaster declaration, the State will be responsible for determining how to allocate the HMGP funding to state and local mitigation actions and projects. Approximately one month after a presidential disaster declaration, the ICC will convene to review the State Hazard

Mitigation Plan. The Plan may need to be updated to reflect the disaster event and any resulting changes to the previously identified mitigation goals and priorities. SCEMD will oversee the execution of recommended revisions to the SHMP and provide an updated plan to FEMA and the ICC members as soon as possible. In addition to the plan review, the ICC will define how HMGP dollars for the event will be prioritized and allocated. Depending on the disaster type, geographic location, and scope of the disaster, a decision will be made if certain regions or types of mitigation activities will be prioritized over others. For example, if a hurricane devastates the entire coast, South Carolina may choose to open funding to the entire state. If the event is a tornado that affects only a few municipalities, a decision may be made to prioritize projects in the affected areas or specifically tornado mitigation projects.

One year after the Declaration, FEMA will provide the State with a funding ceiling or "lock-in" value for HMGP funds. FEMA will provide HMGP estimates prior to 12 months; however these estimates will not represent a minimum or floor amount. At that time, the ICC will collaborate again to finalize the prioritization of post-disaster HMGP funds. Once all applications have been received, the ICC will serve as the Review Panel. Each application will be reviewed for eligibility in accordance with the criteria as defined by 44 CFR Section. 206.434, as well as the guidance outlined in the previous subsection. It is the function of the ICC to review, prioritize, and recommend projects to be submitted to FEMA for funding. The SHMO serves as the coordinator of the committee. All projects must be submitted and approved by FEMA within two years of the Declaration. Any mitigation project that involves construction, such as an acquisition, structure relocation, building elevation, retrofit, safe-room construction, or any work within a floodplain or wetland will require an Environmental Historic Preservation Review. South Carolina recognizes the importance of Native American Tribal Nations and their cultural ties to the land and environment in the State. The Catawba Indian Nation, the state's only federally recognized tribe, is located in the northern portion of the state in York County. Other Indian Nations have culturally significant lands within the state as well. The State will notify each Indian Nation of all proposed mitigation construction projects that may impact culturally significant lands prior to official award of projects.

I. COST-EFFECTIVENESS OF MITIGATION MEASURES

A key criterion for mitigation projects to be eligible for funding is that they must be cost-effective. If the project benefits are higher than the project costs, then the project is cost-effective.

The purpose of this section is to address the process used by the State to determine the cost-effectiveness of mitigation measures and how those mitigation measures are ranked according to the eligibility criteria.

In order to ensure a consistent approach in determining the cost-effectiveness of all mitigation projects, the State will use the FEMA Benefit Cost Analysis (BCA) module and process. Since this is also the method used by FEMA to determine the cost-effectiveness of a project, it is only reasonable that the State use the same method. The benefit cost analysis (BCA) is an assessment of the mitigation project application data to determine whether the cost of investing federal/state/local funds in a hazard mitigation project is justified by the prevented or reduced damages from future disasters. With limited project data and streamlined benefit-cost methods, a cost-effectiveness determination can usually be made quickly and accurately.

It is understood that a positive benefit cost ratio (greater than one) does not necessarily guarantee that a hazard mitigation project will be approved. However, by applying project specific information to the benefit cost analysis module we can get a good initial look at the mitigation potentials associated with that project. The results of this analysis can also help communities evaluate current and future mitigation projects and adjust their overall mitigation strategy accordingly.

The following information serves to summarize the three-step process of determining a mitigation project's cost-effectiveness. This process is used for determining the cost-effectiveness of all mitigation project applications regardless of the type of mitigation measure.

Screen Project Application Data

The first part of the process is screening the project application to gather data relating to cost-effectiveness. This includes economic, environmental, and engineering data. Often, this data is missing or limited. The amount of data available will determine the type of benefit cost analysis to be used. The screening process involves three separate but related tasks. Each task is conducted simultaneously and is essential to developing an overall profile of the project before conducting the benefit cost analysis.

1. Engineering Review - This review establishes whether the project is feasible from an engineering standpoint and whether it will reduce damages as claimed. The reviewer may suggest changes to make the project more efficient in reducing damage and loss.
2. Environmental Assessment - This part of the screening process alerts reviewers to any potential environmental concerns raised by the project.
3. Project Application Data - This part of the screening process determines whether the application contains sufficient information and data for input into the benefit-cost model.

Ideally, the project application would contain all the data needed. However, project applications often have incomplete or limited data. This is one of the main reasons that a streamlined process was developed to determine project cost-effectiveness without all the data. It is also the reason that federal, state, and local mitigation specialists must work closely together to ensure that all proposed mitigation projects are thoroughly reviewed and comply with the mitigation goals and objectives. Rather than require additional information - which may or may not be available and which can cost valuable time and money - FEMA devised shortcuts. With these shortcuts, additional data does not necessarily need to be collected in order to do a benefit cost analysis.

Screening the project data will assist in determining which type of analysis to perform. There is basic data that must be obtained from hazard mitigation applications before a benefit cost analysis can be performed. This data is plugged-in to the benefit cost module to assess whether the project is cost-effective or not.

Benefit Cost Analysis

The second part of the process is to determine which benefit cost analysis tool to use. If the project application data are limited or incomplete, then a benefit cost analysis that uses limited data should be employed. If, however, the data in the project application are more or less complete, then a more robust method of analysis can be used.

Benefit cost analysis is used for all cost-effectiveness determinations. Although the following sample analysis is an oversimplification, the concepts it illustrates are important. At its most basic level, benefit cost analysis determines whether the cost of investing in a mitigation project today (the "cost") will result in sufficiently reduced damages in the future (the "benefits") to justify spending money on the project. If the benefit is greater than the cost, then the project is cost-effective; if the benefit is less than the cost, then the project is not cost-effective. This analysis provides an example of the kind of comparative benefit and cost data you might see after conducting a benefit cost analysis.

It is important to understand that benefit cost analysis is basically the same for each type of hazard mitigation project. The only differences are the types of data that are used in the calculations, depending on whether the project is for floods, hurricanes, tornados, earthquakes etc.

1. Cost-effectiveness is determined by comparing the project cost to the value of damages prevented after the mitigation measure. Given an example where the project cost is $1,000 and the value of damages prevented after the mitigation measure is $2,000.
2. Because the dollar-value of benefits exceeds the cost of funding the project, the project is cost-effective. This relationship is depicted numerically by dividing the benefits by the costs, resulting in a benefit cost ratio (BCR). The BCR is simply a way of stating whether benefits exceed projects costs, and by how much.
3. To derive the BCR, divide the benefits by the cost ($2,000/ $1,000). If the result is 1.0 or greater, then the project is cost-effective. In this instance, the BCR is 2.0, which exceeds the 1.0 level.
4. On the other hand, if the cost of the project is $2,000 and the benefits are only $1,000, the project would have a BCR of 0.50 ($1,000/ $2,000) and would not be cost-effective.

While the example mentioned above may be a simple one, the process and the benefit cost analysis calculations associated with it are basically the same for all mitigation projects.

For all FEMA Hazard Mitigation Assistance grants, FEMA's BCA software version 4.8 must be utilized. This BCA program includes modules for Flood, Hurricane Wind, Tornado Safe Rooms, Earthquake, Wildfire, and Damage-Frequency Assessment. More information and access to the FEMA BCA toolkit can be found at http://www.fema.gov/benefit-cost-analysis. For all other mitigation projects not funded by FEMA, three approaches may be used to determine a project's benefit cost ratio: lower-bound analysis, upper-bound analysis, and best estimate. The lower-bound and upper-bound methods are used in many cases to make final determinations of cost-effectiveness even when there is limited data. In these cases, no further benefit cost analysis is needed. In other cases, quick screening analysis with these approaches yields inconclusive results and additional data and screening may be required.

Lower-Bound Analysis

Lower-bound analysis is a powerful tool that can often demonstrate that projects are cost-effective, in many cases regardless of whether the available data is complete or not. This is an important point, because a project's cost-effectiveness can sometimes be determined by using only one or two key pieces of data. The lower-bound analysis was developed with this in mind.

The lower-bound analysis considers only some of a project's benefits (those that are the most important or those for which data exist) and ignores other benefits that may be difficult to estimate or for which data may not be available. In other words, this analysis purposely uses only a few pieces of information to determine the project's cost-effectiveness and undercounts, or ignores other benefits that will be gained by funding the project. If this data indicates that a project is cost-effective, then no further analysis is needed. No additional data has to be collected.

Lower-Bound Analysis at a Glance

1. It should be used when data is incomplete.
2. It can determine that a project is cost-effective.
3. It cannot determine that a project is not cost-effective.
4. It uses data for one or two significant benefits.

Upper-Bound Analysis

If a lower-bound analysis shows that a project is not cost-effective, then the next step is an upper-bound analysis. Sometimes an upper-bound analysis is used if, at first glance, the project appears not to be cost-effective. Like lower-bound analysis, upper-bound analysis relies on limited project data. Upper-bound analysis, however, also uses professional judgment to estimate about input data that give the highest reasonable benefits that can be expected from a mitigation project.
It is extremely important to note that upper-bound analysis cannot determine that a project is cost-effective. Upper-bound analysis can only determine that a project is not cost-effective.

Because it relies on the highest, reasonable estimate of benefits (prevention of damage by the project), an upper-bound analysis can only determine that the project BCR is not cost-effective (less than 1.0). The project can only be rejected as not cost-effective with this analysis. In other words, because the highest reasonable estimate of damages is used in the calculation, if the BCR is still less than 1.0, one can only conclude that the project is not cost-effective.

Upper-Bound Analysis at a Glance

1. It can only determine that a project is not cost-effective.
2. It is used as the next step if the lower-bound analysis is negative (not cost-effective).
3. It is used if a project appears, at first glance, unlikely to be cost-effective.

4. It uses the highest reasonable estimate of benefits for a project.
5. It analyzes as many data as are possible, assigning the highest reasonable value to each.

Best Estimate Analysis

A best estimate analysis is used when the project application data is complete, or almost complete. This analysis provides a more accurate BCR than either lower-or upper-bound analysis because more data are considered in the analysis. As discussed earlier, however, in many cases lower-bound or upper-bound analysis can provide firm decisions about cost-effectiveness, without requiring as much data as a best estimate analysis.

If a best estimate analysis is conducted, then a project is either cost-effective or not cost-effective, because all significant data are considered. Because this method of benefit cost analysis provides the best estimate of cost-effectiveness, it can be used to rank (set priorities among) competing projects. Neither lower-bound nor upper-bound analysis are used to rank or set priorities among projects. They do not consider enough data to determine accurately specific BCRs; they product only "bounds" on BCRs (i.e. BCR > 1.0 or BCR < 1.0).

Best Estimate Analysis at a Glance

1. It should be used when the project application data is complete, or almost complete.
2. It produces a more accurate analysis than Lower-Bound and Upper-Bound analyses.
3. It determines whether a project is cost-effective or not cost-effective.
4. BCR can be used for ranking or setting priorities among projects.

Results of Benefit Cost Analysis

The final aim of the review process is to determine whether a project is cost-effective, or whether further analysis is required. If the project is cost-effective, the application moves to the next level in the funding process. If it is not cost-effective, the project is rejected. In some cases, additional information may be requested, or the applicant may be shown how the mitigation effort can be re-directed.

By conducting a benefit cost analysis, you determine one of three things: either the project is cost-effective (BCA > 1.0), the project is not cost-effective (BCA < 1.0), or additional data is required.

If the project is cost-effective, then no further analysis or additional data collection is required. If a project is determined to be cost-effective, either by a lower bound or best estimate analysis, then the project moves to the next step in the application process.

If the project is not cost-effective, then no further analysis or additional data collection is required. If the project is determined not to be cost-effective, either by an upper bound or a best estimate, then the project is not eligible for funding. Some projects require additional information to determine cost-effectiveness because the applications are very incomplete.

If the cost-effectiveness of a project cannot be determined, then additional data must be collected. It is important to recognize that only the minimum data necessary to reach a decision on project cost-effectiveness must be collected. In many cases, the collection of one or two more pieces of information are sufficient to reach a decision. A complete analysis is conducted in those relatively few cases where the BCA is close to 1.0.

J. MONITORING IMPLEMENTATION OF MITIGATION MEASURES AND PROJECT CLOSEOUTS

Project Management

Upon notification from the FEMA that a project has been approved and is eligible for funding, the State Hazard Mitigation Officer (SHMO) will notify the sub-grantee and will arrange a meeting to provide the sub-grantee with appropriate information on Section 404 program requirements. SCEMD is the grantee for project management and accountability of funds in accordance with 44 CFR 13. Approved applicants are considered sub-grantees and as such are accountable to the grantee for funds awarded them.

Technical Assistance and Project Monitoring

SCEMD (as grantee) recognizes the responsibilities laid out in 44 CFR 206.438(a): *The State serving as grantee has primary responsibility for project management and accountability of funds as indicated in 44 CFR part 13. The State is responsible for ensuring that sub-grantees meet all program and administrative requirements.*

SCEMD has made a commitment to monitor and provide technical assistance to all eligible and funded sub-grantees. The SHMO, Project Manager, Mitigation Specialist and/or Technical Support will attend sub-grantee meetings to ensure the policies and procedures are explained correctly. Numerous worksheets, financial forms and targeted guidebooks for local officials have been developed by SCEMD and have proven successful.

When necessary, a mitigation team member will meet with sub-grantees quarterly to offer assistance in ensuring the necessary FEMA forms are completed.

Site visits, telephone conversations and facsimiles remain to be the best communication tools for mitigation projects. Past mitigation successes reflect this, and thus, SCEMD is confident the mechanisms outlined will ensure sub-grantees success in administering the Hazard Mitigation Grant Program within Federal and State regulations and policies. A modified Standard Form 270, Request for Advance or Reimbursement will be used by SCEMD for processing fund requests. General principles for processing Requests for Funds are as follows:

1. Verify RFF is original (no facsimiles) and signed by authorized signor.
2. Verify spreadsheet Program Allocated and Administration Allocated columns are correct for the sub-grantee.
3. Verify the Current Draw columns are correct.

4. Check for mathematical accuracy on the RFF.
5. Check for supporting documentation (property list, invoices, equipment and materials costs, etc.).
6. Verify all properties requested to be funded have DOB's released and SHPO clearance.
7. Enter amounts requested on spreadsheet.
8. Forward to Financial Department for processing.
9. Copy all documents to project file.

As a general rule, only 50 percent of administrative funds will be released prior to project closeout.

Cost Overruns

For purposes of the mitigation buyout program, cost overruns are defined to be additional funds necessary to complete the mitigation project defined in the original HMGP Application submitted to FEMA for funding. Cost estimates for mitigation projects, such as acquisition and demolition costs for individual structure/lots, can be somewhat volatile. (NOTE: Property closings resulting in an overrun based on the estimate that can be offset by property closings resulting in a net underrun are not considered cost overruns for this purpose, and thus, do not need FEMA approval as outlined in 44 CFR 206.438(b)).

Immediately upon recognition that an original scope of work that has been approved and funded and then cannot be accomplished with the grant funds allocated, the grant administrator, through the authorized representative of the subgrantee, must submit a request for additional funds with appropriate justification documents to the Governor's Authorized Representative (GAR). Upon receipt, the GAR will review the documents and make a determination. If the request is justifiable, the GAR will forward the request with the State's recommendation to the FEMA Regional Director. If the request is not justifiable, the GAR will deny the request. In no case will the total amount obligated to the State exceed the funding limits set forth in 44 CFR 206.432(b).

Appeals

All sub-grantee appeals to FEMA decisions will be administered in accordance with 44 CFR 206.440.

Quarterly Reports

Quarterly Reports based on a calendar year will be provided to the FEMA Region IV Director as required by 44 CFR 206.438(c).

Project Closeout

Upon completion of a hazard mitigation grant project, the Program Manager and/or Hazard Mitigation Grant Auditor will conduct a closeout site visit to review all files (or a representative sample) and all documents pertaining to the use of 404 and State General Revenue funds. In addition, all procurement files and contracts to third parties will be reviewed. Worksheets have been created to aid in the closeout review.

All reports generated at the closeout site visit are compared with Request for Funds submitted throughout the duration of the program. Any significant findings are reported to the SHMO for final determination and corrective action. Corrective Action notices will be sent to sub-grantees and another site visit will be conducted, if necessary, prior to the release of remaining administrative funds.

Closeout reports will be submitted for each sub-grantee upon expiration of the grant. The closeout report will summarize the following:

1. Grant application and approval award
2. Procurement
3. State Historical Preservation Office
4. Use of administrative allowance
5. Final list of properties acquired, if a buyout project
6. Summary of costs incurred
7. Verification of project monitoring and correspondence
8. Demolition (open space), if a buyout project
9. Certificate of Completion

Closeout reports will be submitted 90 days after notification by quarterly report that a project has been completed, to include demolition (if applicable).

Audit Requirements

44 CFR 14, Administration of Grants: Audits of State and Local Governments, requires all sub-grantees receiving $300,000 ($500,000 after December 31, 2003) or more in Federal assistance to have an audit conducted in accordance with the Single Audit Act. Such reports by an independent Certified Public Accountant will be maintained by SCEMD. All general audit requirements in 44 CFR Part 14 will be adhered to by SCEMD as well as sub-grantees receiving FEMA hazard mitigation grant awards.

General Compliance Assurance Statement

Because of inherent limitations in any grant management program, errors may occur; however, as referenced throughout this Plan, it is SCEMD's intent to comply with all administrative requirements outlined in 44 CFR Parts 13 and 206 in their entirety and to monitor all subgrant supported activities to ensure compliance with 44 CFR Parts 13 and 206 in their entirety.

K. FUNDING SOURCES FOR MITIGATION ACTIONS

The following examples are just a few current and ongoing sources of funding that can be used to implement mitigation actions listed in both the State Hazard Mitigation Plan and local mitigation plans.

Hazard Mitigation Grant Program (HMGP)

HMGP funds are based on a percentage (15% of the first $2 billion and 10% from $2 to $4 billion) of the total federal share of funds received by the State as a result of a presidential disaster declaration. The State can use up to 7% of those HMGP funds for planning purposes and up to 5% for state initiative projects.

Pre-Disaster Mitigation (PDM)

Local Hazard Mitigation plans, plan updates and projects are funded by FEMA's Pre-Disaster Mitigation program. Funding is dependent upon Congressional allocation of funds.

Flood Mitigation Assistance (FMA)

FMA planning funds are received by the State on an annual basis. The amount of funds provided varies. As such, the State establishes priorities for the use of these funds. These funds are provided on a 75/25 cost share basis. The recipient must provide the 25% match. Planning funds can only be provided to jurisdictions that participate in the National Flood Insurance Program (NFIP). The Severe Repetitive Loss (SRL) program was moved under FMA in 2012 (Biggert-Waters Flood Insurance Reform Act) to mitigate properties with more than 4 flood insurance claims. This remains an eligible program with up to a 90% federal cost share. The Repetitive Flood Claims (RFC) grant program was also moved under FMA in 2012 for properties with more than one flood claim.

Of the funding sources listed above, HMGP and PDM funds have been used most frequently to implement activities found in the Mitigation Strategy since this plan was initially approved in 2007.

L. MONITORING PROGRESS OF MITIGATION ACTIONS

EMAP STANDARD
4.4.4: *The Emergency Management Program shall implement a process to monitor overall progress of the mitigation strategies, document complete initiatives, and resulting reduction or limitation of hazard impact in the jurisdiction..*

SCEMD developed and uses a system for tracking the initiation, status, and completion of mitigation activities. This system, called the Mitigation Action Tracking Database, includes the following:

1. A listing of all Mitigation Actions that have been identified,
2. The category of the action (Prevention, Property Protection, Natural Resource Protection, etc.),
3. Hazard(s) addressed by the action,
4. The priority (high, moderate, low) for implementation of the action,
5. The estimated cost to implement the action,
6. Potential and/or current funding sources for implementing the action,
7. The lead agency or department responsible for implementing the action,
8. The implementation schedule,
9. A section for providing a comment on the status of the action's implementation and,
10. Milestones achieved or impediments to implementation of the action.

Each time the plan is updated, the State Hazard Mitigation Officer will update the database. The State Hazard Mitigation Officer will also manage and maintain the monitoring system on a continual basis, including updating the timeframe for carrying out future events and closing out completed or deferred actions that are no longer viable activities. All actions will be maintained within the database by the State Hazard Mitigation Officer with the input of the responsible agencies.

M. CHANGES FROM THE LAST PLAN

Because of FEMA requirements for plan updates, this section was reviewed and analyzed by the ICC as a result of the plan update completed in June 2013. Changes were made to this section to bring it into compliance with the FEMA requirements. Section H, "Post-Disaster Implementation" was added during this plan update to more clearly outline the State's plan for post-disaster funding. Additional updates were made to the Federal mitigation grants section to reflect recent changes in those programs.

VIII. MITIGATION ACTION PLAN

Because of FEMA requirements for plan updates, this section was reviewed and analyzed by the ICC as a result of the plan update completed in July 2012. Changes were made to this section, where necessary, to bring it into compliance with the FEMA requirements. As a benchmark for progress, each action provides an update. Actions that were completed are in green, actions that were deleted are in red, actions that are new (post 2010) are in yellow, and actions that remain valid are in white.

A. GOAL STATEMENT #1: IMPLEMENT POLICIES AND PROJECTS TO PROTECT PEOPLE AND PROPERTY.

The State of South Carolina will implement policies and projects designed to reduce or eliminate the impacts of hazards on people and property.

Mitigation Action	Hazard(s) Addressed	Priority	Category	Goal #	Estimated Cost	Potential/ Current Funding Sources	Lead Agency or Department Resources	Implementation Schedule	Implementation Status	Milestones Achieved, Impediments to Implementation
Provide emergency power supply to Main Campus Computer/Server Room	Hurricane, Flood, Tornado	High	Response, Recovery	1	$250,000	PDM, HMGP	The Citadel			Newly identified Mitigation Action
Expand Campus Emergency Power Supply Loop and Add Switches	Hurricane, Flood, Tornado	High	Response, Recovery	1	$300,000	PDM, HMGP	The Citadel			Newly identified Mitigation Action
Construct Hardened/Dedicated EOC Facility	Hurricane, Flood, Tornado	High	Response, Recovery	1	$425,000	PDM, HMGP	The Citadel			Newly identified Mitigation Action
Register SC Livestock and Poultry Farms and Sites with CULPH	Hazardous Materials	High	Property Protection, Prevention	1	Total cost undetermined	US Department of Agriculture (USDA) Traceability Cooperative Agreement	Clemson University Livestock-Poultry Health (CULPH) - State Animal Health Authority	Ongoing, as able.	In progress	Current number SC premises registered = 5386. Impediments to Implementation: awaiting USDA Final Rule
SC Ag-Watch Project: Educate SC Livestock and Poultry Producers foreign and emerging animal diseases (FAED) and biosecurity	Hazardous Materials	High	Property Protection, Prevention	1	Total cost undetermined	DHS SHSP grants FY07, FY08, FY09 USDA Cooperative Agreement	Clemson University Livestock-Poultry Health (CULPH)	FY08 and FY09 Grants to be completed in 2012	In progress	Training classes held for over 3300 participants to date - Implementation in process of animal health emergency reporting diagnostic

procedures: Develop and implement an animal health emergency reporting diagnostic system.										system
Regional Food and Agriculture Criticality Assessment: A multi-state 3-year project utilizing the DHS-developed Food and Agriculture Sector Criticality Assessment Tool (FASCAT)	Hazardous Materials	Moderate	Prevention; Property Protection; Natural Resource Protection	1	No cost determination at present	Department of Homeland Security SHSP grant FY08	Clemson University Livestock-Poultry Health (CULPH)	Grant goal of collection of state food and agriculture sector data was completed	Ongoing, as able – data may be used in future DHS Data Calls	Database of SC food and ag sector businesses completed July, 2011
Mid-Atlantic Secure Milk Supply project; Provide Continuity of Business for the dairy industry in the event of a Foot and Mouth Disease outbreak	Hazardous Material	High	Property Protection, Prevention	1	Total cost undetermined	FY12 USDA Cooperative Agreement FY13 Cooperative Agreement pending	Clemson University Livestock-Poultry Health (CULPH). Virginia Department of Agriculture and Consumer Services is the lead agency on behalf of 5 states (VA, MD, TN, NC, SC) in the FY12 grant and 7 states (VA,MD,TN, NC, SC, DE, and WV) in the FY grant – this regional project is derived from the national Secure Milk	Ongoing, as able	In progress	Undergoing development in 2012-13; Standardized biosecurity practices for dairy farms, haulers and processing plants.

							Supply project			
Continue development and refinement of campus-wide emergency management protocols	All Hazards	Moderate	Prevention, Property Protection, Emergency Services, Public Information	1		General Fund	College of Charleston			Preparation for all emergency management activities; Protect the lives of our employees and students from natural and man-made hazards.
Continue energy conservation retrofitting of college-owned facilities	All Hazards	High	Property Protection	1		General Fund Grant Funding	College of Charleston	As resources are available		Improve air quality
Retrofit shelter facilities to include backup power and communication systems.	All Hazards	High	Emergency Services	1	$500,000	Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grant, FEMA – All Hazards Emergency Operational Planning, Public Assistance (406 mitigation)	Department of Education	Dependant on funding	Facilities are owned by individual school districts, status can only be determined by surveying all 85 school districts.	2012 - Dependant on funding
Conduct natural hazard vulnerability assessment of all school facilities. Assessments should identify facilities facing a high and moderate level of vulnerability, and protective measures should be identified	All Hazards	High	Prevention	1	$500,000	Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grant, FEMA – All Hazards Emergency Operational	Department of Education	Dependant on funding	Facilities are owned by individual school districts, status can only be determined by surveying all 85 school districts. SCEMD will need to manage such a vulnerability	2012 - Districts are not required to conduct vulnerability assessments of schools. For vulnerability, refer to the State Hazard Mitigation Plan

and implemented.						Planning, Public Assistance (406 mitigation), Flood Mitigation Assistance Program			assessment.	
Retrofit shelter facilities to include backup power and communication systems.	All Hazards	High	Emergency Services	1	$500,000	Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grant, FEMA – All Hazards Emergency Operational Planning, Public Assistance (406 mitigation)	Department of Education	Dependant on funding	Facilities are owned by individual school districts, status can only be determined by surveying all 85 school districts.	2012- Dependant on funding
Conduct natural hazard vulnerability assessment of all school facilities. Assessments should identify facilities facing a high and moderate level of vulnerability, and protective measures should be identified and implemented.	All Hazards	High	Prevention	1	$500,000	Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grant, FEMA – All Hazards Emergency Operational Planning, Public Assistance (406 mitigation), Flood Mitigation Assistance Program	Department of Education	Dependant on funding	Facilities are owned by individual school districts, status can only be determined by surveying all 85 school districts. SCEMD will need to manage such a vulnerability assessment.	2012 - Districts are not required to conduct vulnerability assessments of schools. For vulnerability, refer to the State Hazard Mitigation Plan
Establish backup power (generators and hookups) for education / emergency response facilities.	Hurricanes, Tornado, Thundersto rm	High	Emergency Services	1	$50,000	Hazard Mitigation Grant Program, Emergency Management Performance Grant, FEMA – All	Department of Education	Dependent on funding	Two of three phases complete. Phase three awaiting funding.	2012 - Two of three phases complete. Phase three awaiting funding.

						Hazards Emergency Operational Planning				
Identify and retrofit state school bus maintenance shops. Actions could include the purchase of generators and/or the installation of generator "quick connects", the modification of vulnerable roof design features, improvements to drainage systems, reducing fuel tank and storage vulnerability, and retrofitting communication towers.	All Hazards	Moderate	Property Protection	1	$1,000,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Department of Education, Office of Transportation, Donald N. Tudor	Dependant on funding	Funding is needed to implement this action. Once funding for the action is received, implementation will begin.	2012 - Dependant on funding
Identify and retrofit state school bus maintenance shops. Actions could include the purchase of generators and/or the installation of generator "quick connects", the modification of vulnerable roof design features, improvements to drainage systems, reducing fuel tank and storage vulnerability, and	All Hazards	Moderate	Property Protection	1	$1,000,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Department of Education, Office of Transportation, Donald N. Tudor	Dependant on funding	Funding is needed to implement this action. Once funding for the action is received, implementation will begin.	2012- Dependant on funding

retrofitting communication towers.										
Review application packages and issue permits for construction, repair, alteration, and removal activities.	Flood, Dam Failure, Hurricane, Seismic	High	Prevention	1	$31,500	FEMA Non-Disaster Grant Funding and State Matching Money	DHEC – Dams and Reservoirs Safety Program	Immediate/on going		Generally the Department can adequately review an application within 60 days. However, as more existing dams age and near the end of their design lives additional permits are required creating additional permit reviews.
Perform inspections during and following construction repair, alteration and removal activities of regulated dams.	Flood, Dam Failure, Hurricane, Seismic	Moderate	Property Protection	1	$2,500	FEMA Non-Disaster Grant Funding and State Matching Money	DHEC – Dams and Reservoirs Safety Program	Implemented over the long term or as staff or funding is available.		Currently, inspections are performed at the completion of permitted work.
Construct a public health emergency operations complex consisting of (1) an emergency response vehicle garage/ Strategic National Stockpile receipt, stage, storage site; (2) a public health emergency response materiel stockpile including PPE, lab supplies, infection control supplies, hazardous material response	**Chemical, Biological, Nuclear, Explosive, Pandemic Influenza, Natural Hazards**	**High**	**Health Protection**	**1**	**(1) $1,838,400 emergency response vehicle garage/SNS receiving & staging & storage site (2) $600,000 public health emergency response materiel stockpile (3) $2,329,950 DHEC Emergency Operations Center**	**Requesting state appropriations but not state funds have been appropriated yet.**	**DHEC**	**Once funding is authorized for phases 1, 2, and 3, the projects implementation schedule's will be set.**	**2007 - A Public Health Emergency Pharmacy planning, architectural and engineering studies for the building and site have been completed.**	**2008 - Newly identified Mitigation Action**

equipment; (3) DHEC Emergency Operations Center to support ESF-8 & ESF-10 in addition to the Public Health Emergency Pharmacy located in the same complex.										
Purchase, development and deployment of a notifiable disease surveillance and outbreak management system. Used for surveillance for infectious diseases to include pandemic influenza and biological agents classified as potential weapons of mass destruction and/or high-threat communicable diseases. Outbreak management to occur in the same platform. This will allow the seamless collection, management, analysis and reporting of case and outbreak related data.	Pandemic Influenza, Bioterrorism, Other Disease Outbreaks	High	Health Protection	1	Funding for purchase of software / hardware: $150,000 (completed 2012). Funding for personnel to support development, and deployment: $125,000	CDC Public Health Emergency Preparedness Grant 2012-2012	DHEC – Division of Acute Disease Epidemiology	Actions began with the approval of the grant funding in July 2012. Action must end by the end of the grant in late July 2012.	Software/hardware purchase (Jan 2012), development and configuration ongoing (Jan – Dec 2012), Deployment scheduled for Apr 2013	2012 – Newly Reported Mitigation Action

Support Dune Restoration Efforts	Coastal Storms and Hurricanes; Erosion	Low	Prevention, Property and Natural Resource Protection	1	$100,000	HMA grants, NOAA	DHEC-OCRM	Ongoing	Beach restoration activities do not currently authorize funding for dune stabilization projects.	2009 - New action - Due to potential impacts during turtle nesting season, activities must be coordinated with DNR. DHEC recently established a Keep Off The Dune Sign initiative in partnership with beachfront municipalities.
Establish a Marine Debris Reduction Program	Coastal Storms and Hurricanes	Low	Property and Natural Resource Protection	1	$100,000	HMA grants, NOAA, DHEC, DNR	DHEC-OCRM in conjunction with DNR	Ongoing	DHEC-OCRM and SCDNR have established and funded past marine debris removal programs; however, there are no mechanisms in place for sustained funding	DHEC recently completed abandoned vessel and marine debris removal projects with the City of Folly Beach, the Town of Mt. Pleasant and the City of Georgetown. These efforts resulted in the removal and proper disposal of 22 abandoned vessels. To date, over 80 vessels have been removed from coastal waterways. DHEC is also partnering with the S.C. Sea Grant Consortium on a marine debris education grant.

To provide retrofits that fortify existing homes thereby strengthening those homes against the high winds associated with hurricanes and wind storms.	Hurricane, high-wind storms and other natural disasters	High	Property Protection	1	$4,000,000	HMGP, PDM, State appropriated dollars associated with the SC Safe Home Program	Department of Insurance	This is an ongoing grant program and any additional funds will be used to assist in the retrofit of homes. Due to an overwhelming interest in the program, there currently is a backlog of applications awaiting review by the Advisory Board.	Ongoing	To date, SC Safe Home has awarded more than 1,800 grants totaling more than $7.5 million to retrofit and strengthen existing structures. SC Safe Home is a nationally recognized program and is, at this time the only active mitigation program in the US.
Retrofit Region II (Florence) and Region III (Columbia) Hub Offices to withstand natural disasters and to serve as safe rooms/command centers in the event of disasters	Flood, Hurricane, Tornado	High	Property Protection	1	$382,328	PDM, HMGP	Department of Natural Resources, Kevin Kibler 734-3965	(1) Florence construction start date was 8/26/2009; Florence construction completion date is projected to be 6/26/2010. (2) Columbia Region Hub Office project is currently on hold. (Due to budget related issues)	(1) Florence construction is progressing well and should easily meet its construction completion date deadline of June 26, 2010. (2) Columbia Region Hub Office project is currently on hold. (Due to budget related issues)	2010 - Both the Florence and Columbia Region Hub Office projects have already been partially approved through the State's capital projects approval process which requires approval by both the Joint Bond Review Committee (JBRC) and the Budget & Control Board (B&CB).
Replace bridge, Dam Containment attached to bridge, and realign of roadway to intersection of SC 125 and S-03-17	Earthquake	High	Property Protection	1	$3,000,000	FEMA – Emergency Operational Planning, PDM, HMGP, EMPG, Homeland Security Grants, State Funding	Department of Transportation	Dependent on funding	Dependent on funding	Dependent on funding

Retrofit DOT Critical Facilities throughout the state to withstand hurricane winds and seismic disturbance	Hurricane, Earthquake	Moderate	Property Protection	1	Millions	HMA grants, Homeland Security Grants, EMPG, State Funding	Department of Transportation	FY2012	Dependent on funding	New Mitigation Action created to remove redundancy.
Retrofit 20 radio towers located in the Lowcountry and Pee Dee regions of the state.	Hurricane, Earthquake	Moderate	Property / Equipment Protection	1	$500,000	FEMA – Emergency Operational Planning, PDM, State Funding	Department of Transportation	Identify radio towers for retrofit action in 2008. Contract for design/rebuild /retrofit in late FY 2010	Dependent on funding	Funding currently unavailable
Utilize SCDOT Incidence Response personnel in evacuation assistance of coastal region	Hurricanes	Moderate	Emergency Services	1	Daily expenses – salary, vehicle, operation cot, lodging, meal allowance. Est. $300 - $400/day	HMA grants, Economic Development Administration, PA, EMPG, SBA	Department of Transportation	On standby when hurricane landfall predicted.	On standby when hurricane landfall predicted	Funding currently unavailable
Develop emergency “Lifelines” statewide	Earthquake and Hurricanes	Moderate	Property Protection	1	$1,200,000	FEMA- Emergency Operational Planning, PDM, HMGP, EMPG, Homeland Security Grants, State Funding	Department of Transportation	2008 – Phase I finished; Proposal for Phase II if approved will cover the Lifelines for the entire state and will include Hurricane Evacuation too; Pending on approval of FEMA grant	Proposal sent to FEMA in January – waiting for proposal response	Dependent on funding

Clear and Maintain Stream Channels – Establish and implement emergency maintenance procedures for the removal of debris from bridges and culverts to decrease severity of flooding by downed trees, sediment deposits and other debris in stream and river channels that restrict the flow of water	Flooding	Moderate	Emergency Services	1	$500,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Department of Transportation	Dependent on funding	Dependent on funding	Dependent on funding
Identify critical road drainage concerns in landslide-prone areas. Inspect and retrofit road drainage systems in landslide-prone areas, particularly culverts and culvert outfalls. Where potential slides are unavoidable, prepare design standards for culvert and drainage systems to accommodate passage of debris and water without loss of road profile	Landslides	Moderate	Property Protection	1	$100,000	FEMA- Emergency Operational Planning, PDM, HMGP, EMPG, Homeland Security Grants, State Funding	Department of Transportation	Ongoing	Dependent on funding	Dependent on funding

Upgrade all RWIS (Road Weather Information Systems) across the State with backup satellite communication capability	Snow/Ice Storms, Hurricanes	Moderate	Prevention, Emergency Services and Public Information	1	$1,000 per site	FEMA- Emergency Operational Planning, PDM, HMGP, EMPG, Homeland Security Grants, State Funding	Department of Transportation	3-5 sites year one, 3-5 sites year two and each consecutive year until the state is sufficiently cover by RWIS stations.	Dependent on funding	Dependent on funding
Install RWIS (Road Weather Information Systems) across the State to assist maintenance offices during winter storms.	Snow/Ice Storms, Hurricanes	Moderate	Prevention, Emergency Services and Public Information	1	$3,000 per site	FEMA- Emergency Operational Planning, PDM, HMGP, EMPG, Homeland Security Grants, State Funding	Department of Transportation	3-5 sites year one, 3-5 sites year two and each consecutive year until the state is sufficiently cover by RWIS stations.	Dependent on funding	Dependent on funding
Reinforce or replace grounding devices and lightning protection equipment at dispatch centers as needed.	Lightning, Thundersto rm, Hurricane	High	Property Protection	1	$200,000	Hazard Mitigation Grant Program, Pre Disaster Mitigation, Economic Development Administration – Economic Development Technical Assistance, Public Assistance (406 mitigation), Emergency Management Performance Grants, Small Business Administration – Pre Disaster Mitigation Loans	Forestry Commission	Beginning 2008	2009 - Still looking at improvements or ways to reinforce grounding devices for two (Coastal in Walterboro and PEE Dee in Florence) of the three dispatch centers.	2010 - Completed improvements of grounding devices for lighting protection at Piedmont dispatch center in Newberry in 2009. Need additional funds (possibly Pre-Disaster Mitigation funds) to improve lightning protection at Pee Dee and Coastal Dispatch Centers.

Secure spare generators and make sure they are readily accessible for use when needed.	All Hazards	High	Emergency Services	1	Staff time and resources	Emergency Management Performance Grants	Forestry Commission	FY 2006	Completed	2010 - 13 generators were purchased and placed at critical sites; i.e. repeater sites. Generators at dispatch centers are nearing end-of-life and will be replaced as funding is secured.
Re-roof Coastal and Pee Dee dispatch centers with composite slate.	Thunderstorms, Hurricanes and Wildfire	High	Property Protection	1	$10,000,000	Hazard Mitigation Grant Program, Pre Disaster Mitigation, Economic Development Administration – Economic Development Technical Assistance, Public Assistance (406 mitigation)	Forestry Commission	Dependant on funding	Dependant on funding	2010 - Awaiting funding - possibly Pre-Disaster Mitigation funds.
Reinforce repeater buildings to withstand hurricane force winds.	Hurricane	Low	Property Protection	1	$960,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Forestry Commission	Dependant on funding	Dependant on funding	2010 - Low priority and lack of funds.
Construct or reinforce aircraft hangars to withstand hurricane force winds.	Hurricane	Low	Property Protection	1	$3,000,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Forestry Commission	Dependant on funding	Dependant on funding	2010 - Low priority and lack of funds.

Reinforce radio towers to withstand hurricanes force winds.	Hurricane	Moderate	Property Protection	1	$4,000,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Forestry Commission	Dependant on funding	Dependant on funding	2010 - Need funds: possibly Pre-Disaster Mitigation funds if available.
Strengthen dispatch facilities to withstand hurricane force winds.	**Hurricane, Nor'easter**	**Moderate**	**Property Protection**	**1**	**$10,000,000**	**HMA grants, Economic Development Administration, PA, EMPG, SBA**	**Forestry Commission**	**Ongoing**	**Ongoing: continually seeking ways to improve conditions at dispatch facilities.**	**2010 Completed - Installed hurricane reinforced windows at dispatch facilities**
Ensure that dispatch centers are grounded properly to address lightning.	**Lightning, Thunderstorm, Hurricane**	**Moderate**	**Property Protection**	**1**	**$200,000**	**Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grant, FEMA – All Hazards Emergency Operational Planning, Public Assistance (406 mitigation)**	**Forestry Commission**	**Dependent on funding**	**Continually seeking ways to improve grounding to minimize lightning strikes.**	**2010- Completed - Have installed improved grounding at Piedmont facility in Newberry. Will improve grounding at Pee Dee and Coastal facilities as funds become available.**
Reinforce or replace ground field at radio towers to withstand lightning strikes.	Lightning, Thunderstorm, Hurricane	Moderate	Property Protection	1	$168,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Forestry Commission	Dependent on funding	Dependent on funding	2010 -No progress due to lack of funds - could utilize Pre-Disaster Mitigation funds if available.

Relocate emergency back-up power systems in critical facilities	Flood, Hurricane, Tropical Storm	High	Prevention, Property Protection	1	$41,726,459	HMA grants, General Operating Funds	Medical University of South Carolina	Project can be completed within three years of receipt of funding	Dependant on funding	Applying for funding in 2011. Partial funding received in 2011; applied for additional funding in 2012 cycle; construction projects are underway.
Flood proof critical facilities	**Flood, Hurricane, Tropical Storm**	**High**	**Prevention, Property Protection**	**1**	**$128,647**	**HMA grants, General Operating Funds**	**Medical University of South Carolina**	**Project can be completed within one year of recipt of funding**	**Dependant on funding**	**Applying for funding in 2011**
Install backup generators in shelters and critical facilities.	**All Hazards**	**Moderate**	**Prevention, Emergency Services**	**1**	**$15,000 per generator**	**HMA grants, Economic Development Administration, PA, EMPG, SBA**	**SC EMD**	**Remove**	**Remove**	**Remove**
Incorporate mitigation planning concepts into state legislation and zoning.	**All Hazards**	**High**	**Planning**	**1**	**$75,000**	**FEMA-Emergency Operational Planning, Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grant, Homeland Security Grants, State Funding**	**SC EMD**	**Time span 2-4 years**	**Staff attorney position eliminated due to lack of funding**	**Staff attorney position eliminated due to lack of funding.**

Implementation of warning and detection systems to notify citizens of impending hazards.	All Hazards	High	Prevention, Emergency Services and Public Information	1	$250,000 to $750,000	FEMA-Emergency Operational Planning, Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grant, State Funding	SC EMD	Ongoing	Newly identified Mitigation Action	Staff time and resources
Strengthen critical facilities in earthquake-prone areas of the state.	Earthquake	Moderate	Property Protection	1	$50,000,000 to $60,000,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	SC EMD	As soon as funding is available.	Ongoing - The need is to identify and prioritize the facilities and areas of the state for strengthening.	Impediments: Funding and Staff
Strengthen major / critical bridges to withstand earthquake-related impacts.	Earthquake	Moderate	Property Protection	1	$70,000,000 or more	HMA grants, Economic Development Administration, PA, EMPG, SBA	SC EMD	As funding becomes available.	Ongoing - Identification of bridges for retrofit actions.	Impediments: Staff and Resources
Strengthen major / critical bridges to withstand earthquake-related impacts.	Earthquake	Moderate	Property Protection	1	$70,000,000 or more	HMA grants, Economic Development Administration, PA, EMPG, SBA	SC EMD	As funding becomes available.	Ongoing - Identification of bridges for retrofit actions.	Impediments: Staff and Resources

Retrofit high capacity evacuation shelters (1,000 shelter spaces or greater) to accommodate 3,000-6,000 evacuees. The "super shelters" would undergo roof strengthening, window shutter installation, interior door and wall strengthening, generator connection retrofit, etc. Eight to twelve shelters would be upgraded to "super-shelter" status.	Hurricane	High	Property Protection	1	Cost will vary based on pre-existing condition of shelter. Estimate $500,000 to $1,000,000 per shelter.	HMA grants, Economic Development Administration, PA, EMPG, SBA	SC EMD	Dependent on school district renovation schedule. TBD	Negotiations with Department of Education are ongoing as part of the school facilities planning committee and among other educational institutions.	Milestones achieved are semi-annual meetings are ongoing. Impediments to implementation are availability of dedicated staff and resources for determining suitable priorities for candidate for the project.
Strengthen existing building codes	All Hazards	High	Prevention	1	N/A	N/A	SC Labor, Licensing and Regulation, South Carolina Building Codes Council	July 1, 2012 (projected)	Ongoing	The 2012 Code is now in effect.
Conserve water of specific state parks through construction of rainwater catch basins and implementation of visitor education practices	Drought	Moderate	Property Protection	1	$10,000	HMA grants, existing operating budget	South Carolina Parks, Recreation, and Tourism	Dependant on funding	Continue to install catch basins at other affected parks	2009 - First catch basin installed at Caesars Head State Park
Strengthen all SCPRT structures to withstand earthquake-related impacts	Earthquake	Moderate	Property Protection	1	Millions	Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance	South Carolina Parks, Recreation, and Tourism	Dependant on funding	Dependant on funding	2009 - Impediments: budget, age of facilities; Focus has been on new construction; specifically the

						Grant, FEMA – All Hazards Emergency Operational Planning, Public Assistance (406 mitigation)				redevelopment of Charles Town Landing Visitor's Center and Archaeology Exhibit shed have been added and measures taken to withstand earthquake and hurricane impact.
Retrofit facilities to prevent lightning strikes from damaging equipment and facilities.	Lightning	Moderate	Property Protection	1	$2,000,000	Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grant, FEMA – All Hazards Emergency Operational Planning, Public Assistance (406 mitigation)	South Carolina Parks, Recreation, and Tourism	Dependant on funding	Dependant on funding	2009 - New campground electrical system at Hamilton Branch and Edisto Beach State Parks have lightning arrestors installed; Standard practice of PRT to install surge protectors for computer systems and phone lines; Impediments: manpower/timing, budget. Lightning arrestors placed on facilities to prevent damage to equipment.
Protect and harden historic structures of the SC State Park Service	Lightning, Hurricane, Fire	Moderate	Property Protection	1	$1,000,000	Pre Disaster Mitigation, Hazard Mitigation Grant Program, Emergency Management Performance Grants, FEMA – All Hazards Emergency Operational Planning, Public	South Carolina Parks, Recreation, and Tourism	Dependant on funding	Dependant on funding	2009 - Renovation complete to Table Rock Lodge, Poinsett Bathhouse; Renovations ongoing to cabins at Table Rock and Edisto Beach State Parks; Shutters repaired to Hampton Plantation.

						Assistance				Impediments: age of structures, time constraints, budget. Updated wiring and remodeled several historic structures
Protect and harden select facilities of the SC State Park Service	Lightning, Hurricane, Fire	Moderate	Property Protection	1	$200,000	Pre Disaster Mitigation, Hazard Mitigation Grant Program, Emergency Management Performance Grants, FEMA – All Hazards Emergency Operational Planning, Public Assistance	South Carolina Parks, Recreation, and Tourism	Dependant on funding	Ongoing	2009 - Hurricane shutters installed at Edisto Beach Interpretive Center. New facilities will have sprinkler systems to meet building codes. Tree pruning near facilities
Develop a comprehensive, interagency, flood assessment and mitigation plan to manage floodwater in the Rocky Branch Creek that originates in the City of Columbia and runs through the USC – Columbia campus. Approximately 2 miles of creek-bed and intersecting bridges need retrofitting or replacement.	Flood	High	Property Protection	1	Phase I: $500,000 Phase II: 2,200 linear feet x $5,000 per linear feet = $11,000,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	University of South Carolina	Phase I: Work in conjunction with DOT, City of Columbia, OSE, DNR, the Corps of Engineers and a consulting firm, on a comprehensive flood assessment and mitigation plan for the Rocky Branch Creek and surrounding area. Phase II: Implement the objectives identified in the	Funding is needed to implement this action. Once funding for the action is received, implementation will begin.	2014: Dependent on funding

								plan.		
Upgrade existing storm basins and storm water lines throughout the University of South Carolina - Columbia campus to accommodate greater runoff volumes from impervious surfaces on campus and in the City.	Flood	High	Prevention, Structural Projects	1	Phase I: $500,000 Phase II: Dependent upon assessment	HMA grants, Economic Development Administration, PA, EMPG, SBA	University of South Carolina	Phase I: Work in conjunction with DHEC, City of Columbia to define storm water infrastructure and develop a storm water mitigation plan for the USC Columbia Phase II: Implement actions defined in storm water mitigation plan. Complete GIS mapping and asset review.	Funding is needed to implement this action. Once funding for the action is received, implementation will begin.	2014: Dependent on funding
Install emergency power generators and electrical infrastructure to key facilities, programs and research on campus including the three power plants.	All Hazards	High	Emergency Services	1	$10,000,000	Pre Disaster Mitigation, Hazard Mitigation Grant Program, Emergency Management Performance Grant	University of South Carolina	Phase I: Conduct a needs assessment of required generation and standby power for critical campus facilities. Phase II: Purchase and install generators and electrical infrastructure.	Funding is needed to implement this action. Once funding for the action is received, implementation will begin.	2014: Dependent on funding

Implement a wind retrofit program addressing towers and facilities comprised of significant exterior glass glazing on the Columbia campus.	Thunderstorms and Hurricanes	High	Property Protection	1	Phase I: $200,000 Phase II: Dependent upon assessment	HMA grants, Economic Development Administration, PA, EMPG, SBA	University of South Carolina	Phase I: Conduct an assessment of exterior glass on critical campus facilities. Phase II: Implement actions defined in the assessment.	Funding is needed to implement this action. Once funding for the action is received, implementation will begin.	2014: Dependent on funding
Expand the emergency notification alert system for University of South Carolina system campuses.	All Hazards	High	Emergency Services	1	$250,000	Pre Disaster Mitigation, Hazard Mitigation Grant Program, Emergency Management Performance Grant, FEMA All Hazards Emergency Operational Planning, University of South Carolina	University of South Carolina	Phase I: Install 5 outdoor warning sirens, control panels and 20 alert radios. Phase II: Expand siren system by installing hardware to relay the siren message indoors via voice over fire alarm system.	2008: Phase I complete. Funding is needed to implement this action. Once funding for the action is received, implementation will begin.	2008: Phase I complete. 2014: Dependent on funding
Implement wind retrofit program addressing towers and facilities comprised of significant exterior glass glazing on the Columbia campus.	Thunderstorms and Hurricanes	High	Property Protection	1	Unknown	HMA grants, Economic Development Administration, PA, EMPG, SBA	University of South Carolina, Business and Finance	Dependant on funding	Funding is needed to implement this action.	2009 - Funding currently unavailable
Relocate train tracks to prevent potential exposure to	Hazardous Materials	High	Property Protection, Prevention	1	Phase I: $500,000 Phase II:	Norfolk Southern, City of Columbia, University of South Carolina, FEMA All	University of South Carolina, Norfolk Southern, City	Phase I: Conduct assessment based on	Funding is needed to implement this action. Once	2014: Dependent on funding

chemicals/hazards.					Dependent upon assessment	Hazards Emergency Operational Planning	of Columbia	discussions with Columbia and Norfolk Southern. Phase II: Implement actions defined in the assessment.	funding for the action is received, implementation will begin.	
Protect critical programs and assets on USC Columbia by installing electrical infrastructure for emergency power sources to key facilities, programs and research on campus including three power plants.	All Hazards	High	Property Protection	1	Phase I - Expense covered under DRU grant. Phase II - Dependant upon assessment.	Pre Disaster Mitigation, Hazard Mitigation Grant Program, Emergency Management Performance Grant	University of South Carolina	Start Sept 2009	Phase I - Identify areas of concern with DRU process Phase II - Dependant upon assessment.	2009 - Began the DRU process to identify hazards, vulnerabilities and potential projects. 2010 - USC Columbia installing a backup generator on the computer server annex using University funds.
Evaluate risks associated with train tracks that run through campus to prevent potential exposure to chemical/hazards.	Hazardous Materials	High	Property Protection, Prevention	1	$100,000	Norfolk Southern, City of Columbia, University of South Carolina, FEMA All Hazards Emergency Operational Planning	University of South Carolina, Norfolk Southern, City of Columbia	Based on discussions with Columbia and Norfolk Southern	Phase I: Identify areas of concern with the DRU process Phase II: Implement actions as defined in the DRU mitigation plan.	2009 - Began the DRU process to identify hazards, vulnerabilities and potential projects.
Redevelop the basin for the Rocky Branch Creek that runs through USC - Columbia campus, approximately 2,200 lineal feet of creek bed and intersecting bridges need	**Flood**	**High**	**Property Protection**	**1**	**2,200 linear feet x $4,000 per linear feet = $8,800,000**	**HMA grants, Economic Development Administration, PA, EMPG, SBA**	**University of South Carolina**	**Dependant on funding**	**Funding is needed to implement this action. Once funding for the action is received, implementation will begin.**	**2009 - Dependant on funding**

retrofitting or replacement.										
Install emergency generators at critical facilities across the Columbia campus.	**All Hazards**	**High**	**Emergency Services**	**1**	**20 estimated locations ($400,000 each) = $8,000,000**	**Emergency Management Performance Grants, University of South Carolina**	**University of South Carolina, Business and Finance**	**August 2005 estimated completion date**	**Funding is needed to implement this action.**	**2009 - Funding currently unavailable**
Implement identified flood mitigation projects.	**Flood**	**High**	**Property Protection**	**1**	**Varies**	**HMA grants, Economic Development Administration, PA, EMPG, SBA**	**University of South Carolina**	**Dependant on funding**	**Funding is needed to implement this action.**	**2009 - Dependant on funding**

B. GOAL STATEMENT #2: OBTAIN RESOURCES TO PROTECT PEOPLE AND PROPERTY.

The State of South Carolina will obtain resources necessary to reduce the impact of hazards on people and property.

Mitigation Action	Hazard(s) Addressed	Priority	Category	Associated Goal	Estimated Cost	Potential/Current Funding Sources	Lead Agency or Department Resources	Implementation Schedule	Implementation Status	Milestones Achieved, Impediments to Implementation
Continue responding to hazard emergencies	Haz-Mat, Fires	High	Emergency Services	2	Staff time and resources	General Fund	College of Charleston	Dependant on funding	Dependant on funding	Protecting lives of employees and students natural and man-made hazards; employees and students campus community regarding vulnerability to hazards and steps to reduce vulnerability; preserve environmental resources; preserve historic building inventory; promote long-term resiliency of the college
Development of	All Hazards	High	Public	2	Staff time and	General Fund	College of	Dependant on	Dependant on	Protecting the lives

campus web pages and email blasts for natural and man-made hazards on campus			Information		resources		Charleston	funding	funding	of employees and students from natural and man-made hazards; Minimize future hazardous materials incidents; promote long-term resiliency of the college
Continued use of Cougar Alert system	All Hazards	High	Public Information	2	$50,000/year	General Fund	College of Charleston	Dependant on funding	Dependant on funding	Protecting the lives of employees and students from natural and man-made hazards; Minimize future hazardous materials incidents; promote long-term resiliency of the college
Continued development of campus map including referenced blue prints	All Hazards	High	Emergency Services and GIS	2	$1,500,000	General Fund	College of Charleston	Dependant on funding	Dependant on funding	Protecting the lives of employees and students from natural and man-made hazards; promote long-term resiliency of the college
Continue development of campus EOC/GIS computing / WebEOC center	All Hazards	High	Emergency Services. GIS , Public Information	2	$5,000,000	General Fund and Grant funding	College of Charleston	Dependant on funding	Dependant on funding	Protecting the lives of employees and students from natural and man-made hazards; promote long-term resiliency of the college
Fund the Beach Restoration and Improvement Trust Fund	Coastal Storms and Hurricanes; Erosion	High	Prevention, Property and Natural Resource Protection	2	$5,000,000	State General Assembly	DHEC-OCRM in conjunction with the SC General Assembly	Ongoing	Annual appropriation	In 2008, the SC General Assembly appropriated $4,089,407 for re-nourishment in the DHEC

										supplemental budget. The GA did not utilize the Beach Re-nourishment Trust Fund for re-nourishment appropriations.
Provide back-up generator services to SC's largest food bank that serves as the ESF 18 (donated svcs.) primary distribution agency.	Terrorism, Hurricane, Ice Storms, Biohazards	High	Prevention	2	$2,500,000	Wells Fargo Foundation, Bank of America Foundation, Fluor Foundation, Hollingsworth Fund, Walmart Foundation, Central Carolina Community Foundation, Exxon-Mobil Corporate Giving	Harvest Hope Food Bank	Phase I – Columbia, SC (Priority 1) Phase II – Greenville, SC (Priority 2)	Awaiting equipment purchase and installation.	1.Harvest Hope has identified priority locations needed for back-up generators. 2.Harvest Hope has solicited quotes/preliminary bids for purchase and installation of generators for both Phase I and Phase II. 3.Harvest Hope has identified sites to place these generators at both locations. Roadblock: Private and foundation funding for capital expenditures of this nature for disaster preparedness are rare and are not at a level to make these purchases.
Survey all SA facilities providing essential community services in SC for existing	Flood, Hurricane, Severe Weather, Winter Storms, Tornados	High	Prevention/ Preparedness	2	$500,000	HMGP, Salvation Army property and/or disaster funds	The Salvation Army, North Carolina & South Carolina Division	Phase 1 – Northern/Central /Southern Conglomerate locations. Phase 2- Western Conglomerate	Dependant on funding	

electrical service and to install a transfer switch for back-up power generation.								locations		
Install back-up generator (elevated where necessary) to all SA facilities in SC providing essential community services	Flood, Hurricane, Severe Weather, Winter Storms, Tornados	High	Prevention/ Preparedness	2	$7,500,000	HMGP, Salvation Army property and/or disaster funds	The Salvation Army, North Carolina & South Carolina Division	Phase 1 – Northern/Central /Southern Conglomerate locations. Phase 2- Western Conglomerate locations	Dependant on funding	
Conduct wind retrofits, including but not limited to storm shutters, to SA facilities providing essential community services.	Flood, Hurricane, Severe Weather, Winter Storms, Tornados	High	Prevention/ Preparedness	2	$2,000,000	HMGP, Salvation Army property and/or disaster funds	The Salvation Army, North Carolina & South Carolina Division	Phase 1 – Northern/Central /Southern Conglomerate locations. Phase 2- Western Conglomerate locations	Dependant on funding	
Retrofit identified corrections facilities to withstand earthquake related impacts.	Earthquake	Moderate	Property Protection	2	$1,000,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	SC Dept of Corrections	Dependant on funding	2009- Submitted for review to SCDOC as possible future project.	2009 – Pending special funding/grants.
Implement a real-time seismic monitoring program. Real-time data sensors utilized on critical SCDOT bridges to help managers make	Earthquake	Moderate	Property Protection	2		FEMA – Emergency Operational Planning, PDM, HMGP, EMPG, Homeland Security Grants, State Funding	Department of Transportation	Dependant on funding	Dependant on funding	Dependant on funding

decisions on structural integrity mitigation measures following an earthquake										
Purchase satellite phones for seven district headquarters, forty-six county offices and twenty SCDOT headquarters for issue to inspection teams.	All Hazards	Moderate	Emergency Services	2	Approximately $400,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Department of Transportation	Dependant on funding	Dependant on funding	Dependant on funding
Purchase 800mhz radio systems for SCDOT to include base stations, handheld and mobile.	All Hazards	Moderate	Emergency Services	2	$10,000,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Department of Transportation	Dependant on funding	Dependant on funding	Dependant on funding
Acquire bridge and deck sensors and cameras to monitor icing conditions on major overpasses and critical bridges.	Ice Storm	Moderate	Property Protection	2	$5,000,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Department of Transportation	Dependant on funding	Dependant on funding	Dependant on funding
Purchase 3 Gyro-Trac type machines for mechanical fuels reduction projects in fire-prone communities, or	Wildfire	High	Emergency Services	2	$500,000	National Fire Protection grants, Department of Homeland Security – Assistance to Firefighters Grants	Forestry Commission	As funding becomes available.	Dependant on funding	2013 - Lack of funds to purchase equipment; have contracted out such work and have begun a list of contractors for private landowners

contract with vendors to conduct these treatments.										to contact.
Update or purchase radios (narrow band or 800mhz).	**Wildfire**	**High**	**Emergency Services**	**2**	**$300,000**	**National Fire Protection grants, Department of Homeland Security – Assistance to Firefighters Grants**	**Forestry Commission**	**Dependant on funding**	**Dependant on funding**	**2010 - Completed - Portable radio purchase has been completed and migration to narrowband is underway. Radio console in dispatch centers are beyond end-of-life and need to be replaced as soon as funding source is identified.**
Equip rural fire department brush trucks with foam capabilities to address wildfires.	Wildfire	Moderate	Emergency Services	2	$5,820,000	National Fire Protection grants, Department of Homeland Security – Assistance to Firefighters Grants, National Fire Plan and the Volunteer Fire Assistance (VFA) grants	Forestry Commission	Ongoing as funds allow	Ongoing	2013 - foam capabilities for the rural fire departments have improved. Grant funds can also be used for repairing the brush trucks increasing their capacity to deliver foam.
Provide Automatic Vehicle Locators (AVL) on firefighting equipment.	Wildfire	Moderate	Emergency Services	2	$200,000	National Fire Protection grants, Department of Homeland Security – Assistance to Firefighters Grants	Forestry Commission	As funding becomes available.	Technology exists, yet no funding source has been identified	2010 - Conducted pilot study using cellular network for AVL with some success. Currently evaluating other AVL systems. Utilize National Fire Plan preparedness grant funds to acquire AVL equipment if possible.

Further advance statewide implantation of 211 communication system	Hurricane, Tropical Storms, Wildfires, Floods, Nuclear Events, Pandemic Flu	Moderate	Public Information and Awareness	2	$715,000	$650,000 United Way and United Way Association of South Carolina. Need additional $65,000 to establish disaster response protocols and purchase additional satellite phones.	United Way Association of South Carolina	Dependent upon funding	Wireless and land line capability statewide. Limited VOIP capability. No funding for statewide readiness development.	Continuous funding for statewide readiness monitoring and satellite phones needed.
Emergency Notification System/Weather Monitoring System that would automate real-time weather monitoring with campus wide notification. Emergencies could be communicated to sectors of the community, community wide and/or to public areas. Weather system that allows for plume monitoring should a chemical release occur.	All Hazards	High	Emergency Services	2	$550,000	Pre Disaster Mitigation, Hazard Mitigation Grant Program, Emergency Management Performance Grant, FEMA All Hazards Emergency Operational Planning, University of South Carolina	University of South Carolina	Hire a contractor to write software to automate weather warnings from the National Weather Service to automatically activate the Emergency Notification Systems currently on campus.	Funding is needed to implement this action. Once funding for the action is received, implementation will begin.	2014: Dependent on funding

C. GOAL STATEMENT #3: PROVIDE ENHANCED TRAINING, EDUCATION, AND OUTREACH ON HAZARDS EFFECTS AND INCREASED RESILIENCY.

The State of South Carolina will provide enhanced training, education, and outreach efforts focusing on the effects of hazards, importance of mitigation, and ways to increase resiliency.

Mitigation Action	Hazard(s) Addressed	Priority	Category	Associated Goal	Estimated Cost	Potential/Current Funding Sources	Lead Agency or Department Resources	Implementation Schedule	Implementation Status	Milestones Achieved, Impediments to Implementation
Continue training and coordination activities with the campus emergency operations team	All Hazards	Moderate	Prevention, Property Protection, Emergency Services, Public Information	3	Staff time and resources	General Fund	College of Charleston	Dependant on funding	Dependant on funding	Campus wide coordination and preparation for all emergency management activities; protect the lives of our employees and students from natural and man-made hazards.
Participation in Project Impact with the purpose of improving education on Hazards to the college and community	All Hazards	High	Prevention	3	Staff time and resources	General Fund	College of Charleston	Dependant on funding	Dependant on funding	Protect the lives of our citizens from natural and man-made hazards; educating citizens regarding steps to take to reduce vulnerabilities; improve hazard resistance of infrastructure; reduce vulnerability of our infrastructure to natural and man-made hazards
Continue support of the new campus sustainability program at the College	All Hazards	High	Natural and Beneficial Functions/Resource Preservation Activities	3	$25,000	General Fund Grant Funding	College of Charleston	Dependant on funding	Dependant on funding	Environmental, resiliency, outreach and education programs
Continue hazardous material training	Hazard Materials	High	Emergency Services	3	Staff time and resources	General Fund	College of Charleston	Dependant on funding	Dependant on funding	Protecting lives employees and students from man-made hazards; minimize

										future hazardous materials incidents; preserve environmental resources; improve hazard resistance of infrastructure; assessing vulnerability to man-made hazards
Continue working to attain resources and to provide training for campus community on hurricane, earthquake and other natural hazards in the region	All Hazards	High	Emergency Services	3	Staff time and resources	General Fund	College of Charleston	Dependant on funding	Dependant on funding	Protecting the lives of employees and students from natural and man-made hazards; minimize future hazardous materials incidents; promote long-term resiliency of the college
Establish a standard notification system to alert and train all K-12 school students regarding appropriate preparedness and response procedures.	All Hazards	High	Emergency Services	3	$50,000.00	Pre Disaster Mitigation, Hazard Mitigation Grant Program, FEMA – Emergency Management Performance Grants	Department of Education	Dependant on funding	Dependant on funding	2012- Districts are not required to implement a standard notification system to alert and train students.
Provide training to school (teachers and bus drivers) and Department staff on	All Hazards	High	Public Information and Awareness	3	$25,000.00	Pre Disaster Mitigation, Hazard Mitigation Grant Program, Flood Mitigation Assistance Program (projects, technical assistance), FEMA – Emergency	Department of Education	Dependant on funding	Dependant on funding	2010 - A total of 14 school districts in South Carolina have received the Emergency Response and Crisis Management Grants since 2003.

methods to avoid or manage the impacts of hazards.						Management Performance Grants				This grant includes district training to faculty, staff and teachers on emergency management procedures
Conduct vulnerability assessment of all school bus facilities. Findings should be used to educate school staff on appropriate prevention and mitigation measures.	All Hazards	Moderate	Prevention	3	None entered	Pre Disaster Mitigation, Hazard Mitigation Grant Program	Department of Education	Dependant on funding	Dependant on funding	Dependant on funding
Develop training program for local school facility staff, including hazard-related impacts and how to prepare for, respond to, mitigate against and recover from disasters.	All Hazards	Moderate	Public Information and Awareness	3	$5,000.00	Pre-Disaster Mitigation, Hazard Mitigation Grant Program, FEMA – All Hazards Emergency Operational Planning, Citizen Corps	Department of Education	Dependant on funding	Many districts do provide this training and do have response plans.	Each district has access to the Department of Education's model safe school checklist on the Safe and Drug-Free School's website
Provide an engineer's evaluation of school facilities that are designated for use as shelters. Provide upgrades to the construction to	All Hazards	High	Structural Projects	3	None entered	Hazard Mitigation Grant Program, Emergency Management Performance Grant, FEMA – All Hazards Emergency Operational Planning	Department of Education	Dependant on funding	Dependant on funding.	Dependant on funding

ensure the survivability of these structures.										
Perform workshops/ Seminars that spread dam safety information and education to the public and other government agencies.	Dam Failure	High	Public Education and Awareness	3	$8,500	FEMA Non-Disaster Grant Funding and State Matching Money	DHEC – Dams and Reservoirs Safety Program	Immediate/on going	Dependant on funding	The Dams and Reservoirs Safety Program is understaffed and tasked with many different core functions. This creates an environment where time isn't available to offer workshops and seminars.
The development and implementation of a Statewide Public Awareness Expo held prior to Hurricane Season. Provide a series of workshops geared toward the education and awareness of citizens in SC regarding the need for preparedness and mitigation measures that can be implemented to strengthen and protect their families and	Hurricane, high-wind storms and other natural disasters	High	Life Safety and Property Protection	3	$150,000	HMGP, PDM, and other funding sources to include private and corporate sponsorships.	Department of Insurance	8-2009- Expo and Training Session took place in Charleston, SC. 3-2010- a CE Day was held in Myrtle Beach, SC. The DOI will participate in local community awareness activities throughout 2010. April-June 2012 insurance policy review workshops were held to enhance public awareness of hazards and disaster preparedness.	Ongoing	2009 – The DOI participated with organizations to host the first Expo and Training Session. 2010- the DOI partnered with the Independent Agents and Brokers of SC and The Coastal Carolina Realtors Association to host a CE Day for industry professionals highlighting the incentives set forth by H.3820. 2012 – policy review workshops were conducted statewide. A statewide communication strategy was

properties against natural disasters.										implemented which included a 30 sec public service announcement entitled, *Got It Covered?* that continues to air statewide. The PSA campaign has been enhanced with the addition of a state-wide billboard campaign in which more than 250 billboards have been place throughout the state again carrying the same message, asking consumers if they are covered through their insurance policy for the natural disasters that may impact their home and lives.
SC LIDAR project, phase I, II, and III	Hurricane, flood, landslide, earthquake, sea level rise and climate change	High	Prevention	3	Phase I - $3,800,000; Phase II - $2,150,000; Phase III - $3,850,000	FEMA, Flood Map Modernization, US Army Corps of Engineers, US Forest Service, US Fish and Wildlife Service, US Geological Survey, US Dept. of Agriculture, US Dept. of Energy, SC Dept. of Natural Resources, SC Dept. of Health and Environmental Control, SC Dept. of	Department of Natural Resources	January 1, 2007 through February 28, 2009 (Phase I) January 1, 2009 through December 2010 (Phase II & III)	2008 - Phase I included the collection and processing of LIDAR data for 18 counties. Phase II will complete 11 more counties. Phase III will complete the remaining counties	2008 - Joint funding initiatives have provided the funding for 18.5 counties of the State with four additional counties with existing LIDAR data working to join the consortium Impediments to implementation is

						Parks, Recreation and Tourism, SC Dept. of Transportation, and others in the SC LIDAR Consortium, Pre-disaster Hazard Mitigation Grant, Hazard Mitigation Grant			of SC. PHASE II AND III REQUIRE ADDITIONAL FUNDING.	the shortage of funds to complete the state. Approximately, 5.0 million dollars are needed to complete the statewide LIDAR coverage.
Encourage participation of local governments in the National Flood Insurance Program and the Community Rating System.	Flood	Moderate	Prevention, Public Information and Awareness	3	Staff time and resources	Flood Mitigation Assistance Program (technical assistance), post-disaster assistance via the FEMA Hazard Mitigation Technical Assistance Program, Hazard Mitigation Grant Program	Department of Natural Resources - Flood Mitigation Program	Ongoing	Ongoing. DNR staff continue to work with communities to join the NFIP, CRS and improve their CRS rating.	2009 - Thirty-three (33) communities participate in the CRS program. SC Community activities currently generate approximately $15 million in premium discounts for SC NFIP policy holders.
New coastal storm surge model	Flood, Hurricane, Nor'easter	High	Public Information and Awareness	3	$2,000,000	FEMA Cooperating Technical Partners Program	Department of Natural Resources - Flood Mitigation Program	Ongoing	Funded through cooperating technical partners grant. As part of the Map Modernization Program DNR and their contracts are conducting a statewide storm surge analysis to provide better Flood Insurance Rate Maps.	2009 - The project has been scoped and at this time we are compiling topographic and bathometric data to develop the ADCIRC grid.
Inform high risk communities of practices to implement Firewise principles.	Wildfire	High	Public Information and Awareness	3	Staff time and resources	Pre Disaster Mitigation, Hazard Mitigation Grant Program, FEMA – Emergency Management Performance Grant, National Fire	Forestry Commission	Ongoing as funds allow	Ongoing	2013 - Completed - Plans are completed and being delivered to fire chiefs and interested homeowner associations.

						Protection grants, Department of Homeland Security – Assistance to Firefighters Grants				Utilize National Fire Plan grant funds to conduct assessments and develop Community Wildfire Protection Plans.
Conduct cross training or interagency training with fire departments on smoke mitigation and mop-up following wildfires along highways.	Wildfire	Low	Public Information and Awareness	3	$460,000	Emergency Management Performance Grant, National Fire Protection grants, Department of Homeland Security – Assistance to Firefighters Grants	Forestry Commission	Ongoing as funds allow	In process and ongoing	2013 - Are coordinating efforts for interagency, CTCC region-based All-hazard IMTs (utilizing grant funds from DHS and NFP) Have instructed rural firemen in S-130, S-190, S-215 and made courses available on-line to increase training capacity.
Conduct two Wildland Urban Interface (WUI) training sessions per county to fire department personnel working in the Wildland Urban Interface.	Wildfire	Moderate	Public Information and Awareness	3	$920,000	Emergency Management Performance Grant, National Fire Protection grants, Department of Homeland Security – Assistance to Firefighters Grants	Forestry Commission	Ongoing as funds allow	In process	2010 - Have done 60 workshops statewide with more than 2,500 attending. Plans are underway for additional workshops to target communities with highest risk. Utilize National Fire Plan grant funds.
Host annual Hazard Mitigation Conference	All Hazards	High	Public Information and Awareness	3	$30,000	PDM, HMGP, FMAP (technical assistance), FEMA-EMPG, FEMA- All Hazards Emergency Operational Planning	South Carolina Association of Hazard Mitigation	Occurs yearly	Ongoing	2011/2012 – The 2011 annual had 250 attendees. The conference was a joint conference with the SC Assoc.

										of Hazard Mitigation, and the NC Assoc. of Floodplain Managers held in Charleston, SC. Topics covered such as map modernization, building inspections after disaster events, updating hazard mitigation plans, and mitigation strategies for coastal areas.
Conduct at least one training course each year to discuss hazard related topics including mitigation	All Hazards	Moderate	Public Information and Awareness	3	$400 annually	South Carolina Association for Hazard Mitigation revenues, PDM, HMGP, FMAP (technical assistance), FEMA-EMPG, FEMA- All Hazards Emergency Operational Planning	South Carolina Association of Hazard Mitigation	Ongoing	Ongoing	2011/2012 – SCAHM offered the Certified Floodplain Managers (CFM) Refresher Course in March 2012, which was attended by 25 students. SCAHM and SCDNR provides instructors for the course.
Develop public information evacuation website.	**Hurricane**	**Moderate**	**Public Information and Awareness**	**3**	**$100,000**	**PDM, HMGP, FEMA – EMPG, Citizen Corps**	**SC EMD**	**Remove**	**Remove**	**Remove**
Develop education and outreach program addressing earthquake hazards	Earthquake	Moderate	Public Information and Awareness	3	$100,000	Pre Disaster Mitigation, Hazard Mitigation Grant Program, FEMA – Emergency Management Performance Grant,	SC EMD	2007 - 1st edition began	Funding obtained from EMPG and HMGP. Research and facilitation of development to begin in late 2012. Design Phase in	Development, design, edit, and all facilitation will be done by contractors.

						Mitigation Assistance Program, Citizen Corps, FEMA and Red Cross materials free of charge			early 2013. Bids for publishing in late 2013and distribution in early 2014.	
Develop annually published hurricane awareness newspaper insert.	Hurricane	High	Public Information and Awareness	3	$100,000 for 750,000 copies in English and Spanish; $200,000 for 1,500,000 copies in English and Spanish	Pre Disaster Mitigation, Hazard Mitigation Grant Program, FEMA – Emergency Management Performance Grant, Citizen Corps, FEMA and Red Cross materials free of charge	SC EMD	On-going	On-going	Published annually as an insert through major newspapers and additional copies continually requested through SCEMD public information. Also available free of charge on the SCEMD website.
Local training and outreach on Hazard Mitigation Planning Process. Establish a consistent program for localities to learn the hazard mitigation planning process using both FEMA and SCEMD standards. Make available to local jurisdictions information about programs and funding mechanisms that may	All Hazards	High	Planning	3	$150,000 - $300,000	FEMA-Emergency Operational Planning, Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grant, Homeland Security Grants, State Funding	SC EMD	Time span 3-5 years	Dependent on funding	Staff time and resources

support mitigation projects. Foster local Pre-Disaster Mitigation planning. Assist in identifying existing and potential mitigation projects; increase Public Education and Awareness of Hazards and Mitigation.										
Develop brochure addressing the costs of hazards and the benefits of mitigation.	All Hazards	Moderate	Public Information and Awareness	3	None entered	Pre Disaster Mitigation, Hazard Mitigation Grant Program, post-disaster assistance via the FEMA Hazard Mitigation Technical Assistance Program, Flood Mitigation Assistance Program (technical assistance)	SC EMD	Ongoing	Ongoing	SCEMD website modifications address some mitigation issues but more focus analysis is needed to develop a comprehensive education and outreach program. Additional funding will be needed to research, design, edit, and publish information.
Develop public information evacuation website.	Hurricane	Moderate	Public Information and Awareness	3	$100,000	Pre Disaster Mitigation, Hazard Mitigation Grant Program, FEMA – Emergency Management Performance Grant, Citizen Corps	SC EMD	Dependent upon funding	No update provided	No update provided
Post Disaster Coastal Workshops	Hurricane, Coastal Flood,	Moderate	Public Education and Awareness	3	$7,500		S.C. Sea Grant Consortium	As Needed	In the wake of a hazard event, S.C. Sea Grant's	Workshop funding will need to be secured for

	Coastal Drought								extension program will convene up to three workshops in affected coastal communities to educate stakeholders and residents about the extent of the disaster, recovery status, and mitigation actions to reduce damages from the next similar hazard event.	speaker and participant travel. Workshop timing will depend on speaker availability in the wake of hazard events.
Establish appropriate flood hazards, wind hazards, and signage for the University of South Carolina Campus.	Flood	High	Public Information and Awareness	3	$25,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	University of South Carolina	Install warning signs in each of the flood prone areas on campus	2009: City of Columbia installed 2 warning signs for 1 flood prone area. Funding is needed to continue implementation of this action. Once funding for the action is received, implementation will begin.	2009: City of Columbia installed 2 warning signs for 1 flood prone area. 2013: Funding is needed to install additional signage.

D. GOAL STATEMENT #4: COLLECT AND UTILIZE DATA AND ANALYSES.

The State of South Carolina will collect and utilize data, including conducting necessary studies and analyses, to improve policymaking and identify appropriate mitigation projects.

Mitigation Action	Hazard(s) Addressed	Priority	Category	Associated Goal	Estimated Cost	Potential/Current Funding Sources	Lead Agency or Department Resources	Implementation Schedule	Implementation Status	Milestones Achieved, Impediments to Implementation
Perform reoccurring preliminary inspections of high and significant hazard dams.	Flood, Dam Failure	High	Property Protection	4	$56,500	FEMA Non-Disaster Grant Funding and State Matching Money	DHEC – Dams and Reservoir Safety Program	Immediate/on gong		The Department inspects high hazard dams once every two years and significant hazards every three years. The department generally inspects over 200 dams per year with less than one position currently devoted to this activity.
Monitor precipitation forecast and issue warnings to dam owners	Flood, Dam Failure, Hurricane	High	Prevention	4	$500	FEMA Non-Disaster Grant Funding and State Matching Money	DHEC – Dams and Reservoir Safety Program	Immediate/on gong		The Department just issued a press release on Friday (August 24) that instructed dam owners to safely lower the water levels of their reservoirs.
Following dam failures, conduct evaluations of the failure, related damage and determine improvement	Flood, Dam Failure, Hurricane	High	Prevention	4	$8,500	FEMA Non-Disaster Grant Funding and State Matching Money	DHEC – Dams and Reservoir Safety Program	Immediate/on gong		The Department attempts to perform these inspections as soon as possible. However, some dam owners don't report failures to the department and make repairs

										without our knowledge.
Continue and Expand Beach Monitoring	Coastal Storms and Hurricanes; Erosion	Moderate	Prevention, Property and Natural Resource Protection	4	$250,000	SC Beach Restoration and Improvement Trust Fund, HMA grants, USGS	DHEC-OCRM	Ongoing	The Beach Erosion Research and Monitoring Program (BERM) was developed and collects annual beach profile data to document change in active beach systems	2009 - New action - Data collected through BERM useful should be expanded to include post-storm data collection
The development of a database to track the retrofits and map through the GIS digitized mapping process of properties and information collected through the application process of homes awarded through the grant program, SC Safe Home.	Hurricane, high-wind storms	High	Property Protection	4	$485,000	HMGP, PDM	Department of Insurance	Database is now operational. GIS mapping component will be included when funding is available.	Completed Partially	2010- The SC Safe Home database was developed and is now operational. Further enhancements to include a GIS mapping component are dependent on funding.
Update Flood Insurance Rate Maps statewide through the Map Modernization Initiative.	Flood	High	Prevention	4	~ $21 million	FEMA Map Modernization Program, Flood Hazard Mapping Program, Flood Recovery Mapping (post-disaster), Hazard Mitigation Grant Program, Pre Disaster Mitigation,	Department of Natural Resources - Flood Mitigation Program	Ongoing	Ongoing - Phase one is anticipated to be completed with preliminary maps by September 2014. The state is simultaneously transitioning into phase two known	2012 - County-wide Flood Insurance Studies and Digital Flood Insurance Rate Maps are either preliminary or effective for 40 Counties.

						Flood Mitigation Assistance Program, U.S. Corps of Engineers – Floodplain Management Services			as "RISK MAP" and has received funding for Berkeley, Florence, Lexington, and Richland Counties and the Wateree, Seneca, and Lower Catawba watersheds .	
Conduct assessment of Severe Repetitive Loss (SRL) properties. Develop strategy to mitigate existing and future SRL properties.	**Flood**	**High**	**Property Protection**	**4**	**$25,000**	**Flood Mitigation Assistance Program**	**Department of Natural Resources - Flood Mitigation Program**	**To be completed by December 2007**	**Newly identified Mitigation Action**	**2008 - Completed and a confidential copy of the report was provided to EMD**
Establish Severe Repetitive Loss (SRL) & Repetitive Flood Claims (RFC) Programs	**Flood**	**High**	**Property Protection**	**4**	**$15,000**	**Flood Mitigation Assistance Program**	**Department of Natural Resources - Flood Mitigation Program**	**To be completed by December 2008**	**Update the State Hazard Mitigation plan to incorporate SRL and RFC Guidelines. Work with communities to develop applications to mitigate targeted properties.**	**2008 - State Hazard Mitigation Plan amended to include SRL requirements. State is now eligible for 90/10 SRL cost share. Applications involving individual property owners are voluntary.**
Retrofit agency Region IV coastal buildings to prevent substantial loss in the event of most	Flood, Hurricane, Nor'easter, Tornado	High	Prevention	4	$300,000	PDM, HMGP	Department of Natural Resources, Kevin Kibler 734-3965	(1) MRRI construction start date was 10/2/08; MRRI construction completion date is projected to be 4/12/2010. (2) Quarantine	(1) MRRI has progressed nicely and is essentially complete. (2) Quarantine Officers Quarters renovation is progressing well	2010 - Many of the agency's Region IV Building have already been approved for state funding to accomplish retrofit/upgrade

natural disasters.								Officer's Quarters construction start date was 4/1/08; Quarantine Officer's Quarter construction completion date is project to be 11/10. (3) Marshlands House construction start date was 6/7/07; Marshlands construction completion date is project to be 2/11.	and should easily meet its estimated completion date. (2) Marshlands House renovation is progressing well and should easily meet its estimated completion date.	work. These projects include: Historic Houses and Structures Repairs – $2,200,000 and Marine Resources Research Institute building in Charleston – $5,000,000
Improve current state and federal research programs addressing drought.	Drought	Moderate	Prevention	4	None entered	Pre Disaster Mitigation, Hazard Mitigation Grant Program, Emergency Management Performance Grant	Department of Natural Resources – State Climate Office	Ongoing	Ongoing	2013 - Dependant on funding
Identify soils under and around roadways that are subject to liquefaction	Earthquake	Moderate	Property Protection	4	$2,000,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Department of Transportation	Dependent on funding	Dependent on funding	Dependent on funding
Improve bridge safety by evaluating the potential of future flood damages during the base flood discharge to existing bridges and overpasses in flood hazard	Flooding	Moderate	Property Protection	4	$100,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	Department of Transportation	Ongoing	Dependent on funding	Dependent on funding

areas. The assessment should identify those transportation structures at risk and develop appropriate retrofitting options.										
Gather smoke dispersal information from wildfires and prescribed burns and enter data into a smoke model to predict smoke dispersal patterns.	Wildfire	High	Prevention	4	$200,000	National Fire Protection grants, Department of Homeland Security – Assistance to Firefighters Grants	Forestry Commission	Ongoing as funds allow	Ongoing process of gathering information from wildfires and prescribed burns to enter into smoke model to predict smoke dispersal. Working with US Forest Service and University of Georgia to validate the Piedmont smoke model.	2010 - Smoke model which is located in GA is not always on-line and model has not been validated. Continue to work with partner agencies to develop a reliable smoke prediction model.
Utilize Southern Wildfire Risk Assessment data to determine wildfire risk, conduct Firewise workshops and place prevention education teams.	Wildfire	High	Public Information and Awareness	4	$500,000	Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grant	Forestry Commission	Ongoing as funds allow	Ongoing process especially in analyzing the Southern Wildfire Risk Assessment Data.	2012- Have conducted workshops in communities with moderate to high wildfire risk, and wildfire prevention teams have been deployed annually throughout the state.
Develop alternate access routes for fire	Earthquake	Moderate	Emergency Services	4	Staff time and input from SCEMD	FEMA – Emergency Management Performance Grants, Mitigation Assistance	Forestry Commission	FY 2010	Currently working with DOT	2010 - With current Computer Aided Dispatch System (CADS)

suppression equipment following an earthquake.						Program, FEMA – All Hazards Emergency Operational Planning				software is available to gather alternate route information to assist with access. Also, we can utilize our aircraft to fly over incident to identify alternate routes.
Conduct state-specific wildfire risk assessment using Southern Wildfire Risk Assessment data.	Wildfire	Moderate	Prevention	4	$1,000,000	Pre Disaster Mitigation, Hazard Mitigation Grant Program	Forestry Commission	Ongoing as funds allow	Ongoing	2013 - Will continue to update the Southern Wildfire Risk Assessment with current wildfire occurrence data and accurate fuels information.
Communities located in high risk areas should implement Firewise program.	Wildfire	Moderate	Prevention, Public Information and Awareness	4	Staff time and resources	Pre Disaster Mitigation, Hazard Mitigation Grant Program	Forestry Commission	Ongoing as funds allow	The South Carolina Forestry Commission continues to promote and support the implementation of the Firewise program across the state.	2013 – Sixteen communities across the state have achieved "Firewise Community USA" status. These communities have an approved community wildfire protection plan and implement Firewise principles
Develop wildfire mitigation plans in high risk communities.	Wildfire	Moderate	Prevention	4	$150,000	FEMA – Emergency Operational Planning, Pre Disaster Mitigation, Hazard Mitigation Grant Program, Emergency Management Performance Grant, National Fire Plan grant	Forestry Commission	Ongoing as funds allow	Ongoing	2013 - Have developed over 768 wildfire risk assessments that are distributed to local fire chiefs that serve the community and a copy to the HOAs to encourage

										having Firewise workshops. Utilized National Fire Plan grant funds to conduct assessments and develop Community Wildfire Protection Plans.
Create a Disaster Resistant University All Hazard Mitigation Plan	All Hazards	High	Prevention	4	$200,000	HMA grants, General Operating Funds	Medical University of South Carolina	Start Sept 2011	Dependant on funding	Applying for funding in 2011. Funding received in 2011; plan is in progress
Plan and develop a Center for Health Professional Training and Emergency Response (CHPTER)	All Hazards	High	Prevention	4	$600,000	State Law Enforcement Division (SLED), SC Hospital Association, Agency for Healthcare Research and Quality (AHRQ), US Department of Health and Human Services (HHS), Department of Homeland Security (DHS), non-profit organizations, non-governmental organizations, private philanthropy	Medical University of South Carolina	Project can be completed within three years of receipt of funding	Dependant on funding	Applying for funding in 2011. Partial funding received in 2011; applied for additional funding in 2012 cycle; CHPTER is in progress with partial funding
Develop and implement a comprehensive COOP strategy to include planning, training, alternate facility, and equipment	All Hazards	Moderate	Prevention	4	$10,000	HMA grants	South Carolina Department of Public Safety (SCDPS)	As funding becomes available.	The Department of Public Safety has completed a COOP; however funding is required to provide for true cross-training of personnel, the purchase of redundant equipment	Planning has been initiated, but funding for large-scale continuity support is uncertain.

									(especially IT) and the identification and equipping of an alternate SCDPS HQ.	
Re-map coastal surge zones using LIDAR.	Flood, Hurricane, Nor'easter	High	Prevention	4	$2,000,000	FEMA Map Modernization Program, Flood Hazard Mapping Program, Flood Recovery Mapping (post-disaster), Pre Disaster Mitigation, Hazard Mitigation Grant Program, U.S. Corps of Engineers – Floodplain Management Services, Flood Mitigation Assistance Program	SC EMD	Phase I - Beaufort: Other counties are ongoing	Implementation moving forward in coastal counties and statewide (already exists in Charleston, Colleton, Jasper and Beaufort)	Statewide Consortium and accumulation of data is in progress to avoid duplication of efforts, identify and implement areas such as Horry, Berkeley, and Georgetown Counties in coastal surge zones.
To acquire and implement an updated mitigation database software to manage mitigation grants, track ongoing mitigation initiatives and strategies and to support local, state, and federal grant application requirements, grant management and tracking projects once	All Hazards	High	Planning	4	$100,000	Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grants	SC EMD	As funding becomes available	Dependent upon funding.	Dependent upon funding.

completed.										
Mitigation Success Stories Development - Develop a simple method to identify and record the ongoing mitigation success stories from across the state. Identify the critical data needed to show the full benefits of these actions over time.	All Hazards	High	Planning	4	$75,000	FEMA-Emergency Operational Planning, Hazard Mitigation Grant Program, Pre Disaster Mitigation, Emergency Management Performance Grant, Homeland Security Grants, State Funding	SC EMD	Time span 3-5 years	Ongoing – Staff tracks all mitigation projects.	Staff time and resources
Develop data distribution standards for the mitigation database to address data security, sharing and Freedom of Information Act (FOIA) issues.	All Hazards	Moderate	Planning	4	$45,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	SC EMD	Time span 2-4 years	Dependent upon funding	Staff time and resources
Conduct detailed HAZUS-MH studies	Earthquake, Flood, Hurricane	Moderate	Prevention	4	None entered	Pre Disaster Mitigation, Hazard Mitigation Grant Program, Flood Mitigation Assistance Program (technical assistance)	SC EMD	None entered	In progress.	Staff time and resources
Develop detailed seismic maps	Earthquake	Moderate	Prevention	4	None entered	Pre Disaster Mitigation, Hazard Mitigation Grant	SC EMD	Ongoing	Seismic maps are being prepared as HAZUS-MH studies	Seismic maps were used during the 2007 two-day full

and mapping effects of historical SC earthquakes. Will be used to validate earthquake loss scenarios and allow effective mitigation actions.						Program, Mitigation Assistance Program, Emergency Management Performance Grants			are being completed.	scale exercise for mitigation planning. Seismic maps are referred to for mitigation actions by local jurisdictions and the public.
Track and map space available for pets at local SPCA and other animal shelters	All Hazards	Low	Planning	4	$45,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	SC EMD	Time span 3-5 years	Dependent upon funding.	Staff time and resources
Supporting Coastal Drought Impact Reporting	Drought	Moderate	Public Education and Awareness	4		National Integrated Drought Information System (NIDIS)	SC State Climate Office, S.C. Sea Grant	2013-2014	A NIDIS subcommittee is developing a project to identify what drought impacts are on coastal ecosystems and enable stakeholders to more easily report drought impacts to state authorities in NC and SC. The project is being developed through 2014 and will require local input for the format of the reporting system. After 2014 the reporting system will need continued publicizing and routine	Final format of the impact reporting system will depend on stakeholder input to be gained during the 2013 workshop, making it difficult to estimate costs to maintain the system after its development in terms of staff time or required presence on an agency server.

									maintenance to operate (for example, monitoring data reported through a mobile app).	
Develop management plan to control erosion of coastal state parks.	Coastal Erosion	High	Prevention	4	$200,000	U.S. Corps of Engineers – Planning Assistance to States, Floodplain Management Services, Nonstructural Alternatives to Structural Rehabilitation of Damaged Flood Control Works; Natural Resources Conservation Service – Watershed Surveys and Planning, Wetlands Reserve Program; Environmental Protection Agency – Wetlands Grants, Economic Development Administration – Disaster Mitigation Planning and Technical Assistance	South Carolina Parks, Recreation, and Tourism	Ongoing	Ongoing - Sand pumping at Edisto Beach and Hunting Island completed 6/06 - Placement of groins at Hunting Island currently taking place.	2009 - 240,000 cv of sand pumped onto shoreline at Edisto Beach State Park, 570,000 cv of sand pumped onto beach at Hunting Island. Sand fencing installed at Edisto Beach and Hunting Island, Groin placements at Hunting Island complete. South end cabin road has been permanently destroyed by erosion. No plans to rebuild/relocate eliminating vehicle access to these 4 state owned properties
Develop Management Plan to protect park facilities and properties.	Hurricane	Moderate	Prevention	4	$200,000	HMA grants, Economic Development Administration, PA, EMPG, SBA	South Carolina Parks, Recreation, and Tourism	Ongoing	Ongoing/complete, Parks will update as needed,	2009 - Each state park has developed an Emergency Action Plan to include action to be taken in the event of an approaching hurricane as well as during its aftermath (see

										example from Hunting Island State Park). This includes evacuation of visitors
Develop a Continuity of Operations Plan for SLED	All Hazards	High	Prevention	4	$10,000	HMA grants	State Law Enforcement Division (SLED)	As funding becomes available.	Dependent upon funding	Dependent upon funding
Coordinate with locals in all 46 counties to conduct capability, risk, and vulnerability assessments	Terrorism	High	Prevention	4	$5,000	Homeland Security Grants	State Law Enforcement Division (SLED)	TBD	Dependent upon funding	Dependent upon funding
Improve information sharing, intelligence collection, and collaboration between SLED, local law enforcement and other local agencies by providing training and development of programs for intelligence led policing efforts and local intelligence collection	Terrorism	High	Prevention	4	Staff time and resources	SLED budget	State Law Enforcement Division (SLED)	Ongoing	Funding has been identified for some aspects. SLED has developed and implemented a Suspicious Activity Report process.	2012- Dependent upon funding
Complete a Disaster Resistant University All	All Hazards	High	Prevention	4	$217,000	HMA grants, Economic Development Administration, PA,	University of South Carolina	Start Sept. 2009 – Complete Sept. 2012	2009: USC was awarded PDM funding and planning has begun	2009: PDM planning grant was acquired, PBS&J was selected, and

Hazards Mitigation Plan						EMPG, SBA				planning has begun. Audits conducted at Aiken, Upstate, Sumter, and Beaufort. 2013: Project complete
Develop high wind safety plan to secure campus.	**Thunderstorm Tornado**	**Moderate**	**Emergency Services**	**4**	**Unsure**	**Pre Disaster Mitigation, Hazard Mitigation Grant Program, University of South Carolina, Technical guidance available from FEMA**	**University of South Carolina**	**Dependant on funding**	**Funding is needed to implement this action. Once funding for the action is received, implementation will begin.**	**2009 - Dependant on funding**

E. GOAL STATEMENT #5: IMPROVE INTERAGENCY COORDINATION AND PLANNING.

The State of South Carolina will improve interagency coordination and planning to reduce the impact of hazards on people and property.

Mitigation Action	Hazard(s) Addressed	Priority	Category	Associated Goal	Estimated Cost	Potential/Current Funding Sources	Lead Agency or Department Resources	Implementation Schedule	Implementation Status	Milestones Achieved, Impediments to Implementation
Continue coordinating Emergency Operations Center activities related to a hazard event, including holding drills for EOC personnel	All Hazards	High	Emergency Services	5	$15,000	General Fund	College of Charleston	Dependant on funding		Protecting lives of employees and students from natural and man-made hazards; educating citizens regarding vulnerability to hazards and steps to reduce vulnerability; preserve environmental resources; promote long-term resiliency of the college
Coordinate with all SC counties to designate burn sites for disaster debris disposal after disaster.	**All Hazards**	**Moderate**	**Natural Resource Protection**	**5**	**$18,000**	**State Monies Hazard Mitigation Grant Monies**	**DHEC – Bureau of Air Quality Staff of Environmental Services Staff**	**Coordination activities will begin 30-45 days after initial start of project**	**Burn site selection already determined to coastal counties for 2010. Midland and Upstate counties will be determined shortly after grant approval.**	**2009 – New action 2010. Waiting on Grant approval.**
Communicate the need to identify disaster debris management sites and provide	All Hazards	Moderate	Natural Resource Protection	5	$20,000	State Monies Hazard Mitigation Grant Monies	DHEC – Bureau of Air Quality Staff, Bureau of Land and Waste Management, Bureau of Environmental	Coordination activities will begin 30-45 days after initial start of project	Burn site selection already determined to coastal counties for 2010. Midland and Upstate counties will be determined	Identification and approval of sites lies with the county or local jurisdiction.

technical assistance when requested.							Services Staff		shortly after grant approval.	
Improve hazard mitigation along non-beachfront coastal shorelines	Coastal Storms and Hurricanes; Erosion	Moderate	Prevention, Property and Natural Resource Protection	5	$100,000	HMA grants, NOAA, DHEC, DNR	DHEC-OCRM in conjunction with SCEMD, DNR, Sea Grant	Ongoing	State currently does not have similar mapping, monitoring, planning, and regulatory frameworks for non-beachfront shorelines in the coastal zone.	DHEC-OCRM entered into a contract with SCDNR Geological Survey to inventory estuarine shoreline data, and develop a protocol for long-term monitoring. Under the Silver Jackets Program, the Charleston District of the U.S. Army Corps of Engineers, in conjunction with DHEC-OCRM and the NOAA Coastal Services Center, is assessing estuarine shoreline positions, alterations, and erosion rates for the coastal area extending from the Savannah River to Edisto Island. This ongoing project is expanding upon the pilot mapping project performed by the SC DNR Geological Survey by including a greater area, digitizing both historical shorelines and modern shorelines,

										and analyzing shoreline changes. Once the shoreline data for the project area has been digitized and erosion rates have been calculated, DHEC-OCRM will incorporate the results into technical assistance documents for local governments and the public upon request. It is essential for estuarine shoreline outreach material to contain erosion rate and armoring information for them to facilitate improved planning at the local level.
Improve Coastal Hazard Mitigation Strategies	Coastal Storms and Hurricanes; Erosion	Moderate	Prevention, Property and Natural Resource Protection	5	$100,000	HMA grants, NOAA Coastal Management Fellowship Hazard Mitigation Grant Monies	DHEC-OCRM with assistance from SCEMD, SC Sea Grant, Universities	2 years	Most beachfront communities have adopted hazard mitigation plans and local comp. beach mgmt. plans. There remains a need for long-term post-storm redevelopment strategies	2009 - funding needed to support a staff member. 2011- NOAA Coastal Management Fellow is developing a Beachfront Vulnerability index to assist DHEC with planning and regulatory functions. 2012- DHEC has begun coordination with State

										Department of Insurance and other agencies to update a Purchasing Coastal Real Estate Q/A, including information on hazards and mitigation.
During dam failures, activate dam failure advisory team and man the SEOC.	Flood, Dam Failure, Hurricane , Seismic	High	Emergency Services	5	$7,000	FEMA Non-Disaster Grant Funding and State Matching Money	DHEC – Dams and Reservoirs Safety Program	Immediate/on going		The Dams and Reservoirs Safety Program has been working closely with SCEMD and has participated in several training events at the SEOC facilities.
Develop Statewide Drought Management and Mitigation Plan.	Drought, Wildfire	High	Prevention	5	$15,000 - $25,000	Hazard Mitigation Grant Program, Pre-Disaster Mitigation	Department of Natural Resources	Dependent on the acquisition of state or federal funding.	Funding is needed to implement this action. Once funding for the action is received, implementation will begin.	2013 - Pending special funding/grants.
Planning, development and training for rapid recovery donated goods resource distribution sites throughout the state.	All Hazards	Moderate	Emergency Services	5	400 man hours at $20 per hour. Total $8,000	ACS, South Carolina EMD and local interested parties will jointly develop a plan for sites and implementation strategies including ongoing training program for rapid recovery donated goods resource distribution statewide.	Seventh Day Adventists	Planning 12 months, Training development 6 months, Training implementation - ongoing	Dependant on funding	2013 - Dependant on funding
Incorporate mitigation planning concepts into	All Hazards	Moderate	Planning	5	$75,000	FEMA-Emergency Operational Planning, Hazard Mitigation Grant Program, Pre	SC EMD	Time span 3-5 years	Dependent upon funding	Staff time and resources

Continuity of Operations Plans (COOP) for state agencies.						Disaster Mitigation, Emergency Management Performance Grant, Homeland Security Grants, State Funding				
Develop local, state-wide communications capability for emergency planning and response.	All Hazards	High	Emergency Services	5	$100,000	FEMA – Emergency Operational Planning, Pre Disaster Mitigation, Hazard Mitigation Grant Program, Emergency Management Performance Grant, South Carolina Department of Transportation	SC EMD	Annual update: 2000-2010	WebEOC, a multi-user EOC Information has been funded throughout the state. ReachSC, a telephonic citizen notification system has been funded throughout the state.	Update for WebEOC and ReachSC may be received annually or as needed.
Develop severe weather shelter safety plans for the University of South Carolina system.	Tornado, Thunderstorms	High	Prevention, Emergency Services	5	Phase I: Expense covered under PDM grant. Phase II: $200,000 Phase III: Dependent upon assessment.	Pre Disaster Mitigation, Hazard Mitigation Grant Program, Technical guidance available from FEMA	University of South Carolina	Start Sept. 2009 – Complete Sept. 2012	Phase I: Complete Phase II: Perform a detailed shelter assessment of campus facilities. Phase III: Implement actions as defined in the mitigation plan and the shelter assessment to create an approved shelter.	2009: Began the Phase I to identify hazards, vulnerabilities and potential projects. 2013: Phase I complete. 2014: Implementation of phases 2 & 3 dependent on funding

F. GOAL STATEMENT #6: ENHANCE COMPLIANCE CAPABILITIES TO REDUCE HAZARDS IMPACT.

The State of South Carolina will enhance compliance capabilities in order to reduce the impacts of hazards on people and property.

Mitigation Action	Hazard(s) Addressed	Priority	Category	Associated Goal	Estimated Cost	Potential/Current Funding Sources	Lead Agency or Department Resources	Implementation Schedule	Implementation Status	Milestones Achieved, Impediments to Implementation
Continue enforcement of the International Series Building, environmental safety and fire codes	All Hazards	High	Prevention, Property Protection	6	Staff time and resources	General Fund	College of Charleston	Dependant on funding		Minimize potential flood damage; minimize future earthquake damage; minimize future hurricane damage; protect the lives of our employees and students from natural and man-made hazards
Issue Maintenance, Inspection & Repair, and Emergency Orders to unsafe regulated dams	Flood, Dam Failure	High	Prevention	6	$56,500	FEMA Non-Disaster Grant Funding and State Matching Money	DHEC- Dams and Reservoirs Safety Program	Immediate/on going		DHEC generally attempts to obtain voluntary compliance in regards to maintenance. If the dam owners refuse to comply these orders are issued.
Require drought mitigation plans for industry and municipal public works departments.	Drought	High	Prevention	6	Staff time and resources	Natural Resources Conservation Service – Watershed Protection and Flood Prevention Program	Department of Natural Resources	Ongoing	No progress to date.	2010 - The Drought Response Act has not been amended to require drought mitigation plans.
Amend Drought Response Act 49-23-70 and	Drought, Wildfire	High	Prevention	6	Staff time and resources	NA	Department of Natural Resources – State Climate	Will require legislative approval during the normal Legislative Session	No progress to date.	2010 - The Drought Response Act has not been amended to require drought

supporting regulations. Major amendments should include: 1) Requiring municipal water systems, industry and lake owners responsible for the provision of water for public or private use to develop Drought Management Plans; 2) Remove the involvement of the Administrative Law Judge Division in the drought declaration process.							Office	(January-June). Several public hearings held between stakeholders and the Department of Natural Resources will be required to work through any issues before it is submitted.		mitigation plans, and the Administrative Law Judge Division is still involved in the drought declaration process.
Establish state law requiring municipal storm drainage systems to flow at 80% of design capacity.	Flood	Moderate	Prevention	6	Staff time and resources	HMA grants	Department of Natural Resources	Currently no law in place	Currently no law in place	2010 - Currently no law in place

G. GOAL STATEMENT #7: ENHANCE THE USE OF NATURAL RESOURCE PROTECTION MEASURES.

The State of South Carolina will enhance and encourage the use of natural resource protection measures as a means to reduce the impacts of hazards on people and property.

Mitigation Action	Hazard(s) Addressed	Priority	Category	Associated Goal	Estimated Cost	Potential/Current Funding Sources	Lead Agency or Department Resources	Implementation Schedule	Implementation Status	Milestones Achieved, Impediments to Implementation
Re-nourish Hunting Island State Park.	Hurricane, Coastal Erosion, Nor'easter	High	Structural Projects	7	$20,000,000	U.S. Corps of Engineers – Planning Assistance to States, U.S. Corps of Engineers – Emergency Streambank and Shoreline Protection, U.S. Corps of Engineers – Beach Erosion Control Projects, U.S. Corps of Engineers – Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works, Beach Re-nourishment Trust Fund,	South Carolina Parks, Recreation, and Tourism/Maintenance and Engineering	Within one year of funding	2008 - Groins completed	2009 - 570,000 cy of sand pumped onto the beach at Hunting Island at a cost of $4.4 million, Currently completing installation of six 500' long groins at a cost of $2.9 million, 20,000 sea oats donated and planted in dunes by volunteers. 4 state owned rental cabins have been destroyed by erosion - no plan for replacement (2009)
Maintain healthy beach profile.	Hurricane, Coastal Erosion, Nor'easter	High	Structural Projects	7	None entered	U.S. Corps of Engineers – Planning Assistance to States, U.S. Corps	South Carolina Parks, Recreation, and Tourism/Maintenance and	Ongoing	Ongoing	2008 - 20,000 donated sea oats planted by volunteers at Hunting Island

						of Engineers – Emergency Streambank and Shoreline Protection, U.S. Corps of Engineers – Beach Erosion Control Projects, U.S. Corps of Engineers – Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works, Beach Re-nourishment Trust Fund	Engineering			State Park, 10,000 donated sea oats planted by Edisto Beach State Park, Foot traffic re-routed at Edisto Beach away from susceptible dune areas to allow for re-vegetation of native plants, Ongoing maintenance of dune crosswalks at all beach park locations, Current boardwalk project at Myrtle Beach State Park in effort to take pressure off dunes ($500,000 LWCF grant), Routine maintenance and housekeeping of 8 miles of state park shoreline.

IX. PLAN MAINTENANCE PROCEDURES

FEDERAL REQUIREMENTS FOR STATE MITIGATION PLANS **44 CFR 201.4(c)(5)(i):** *[The State plan should detail the State's] established method and schedule for monitoring, evaluating, and updating the plan.*

This plan is not a static document. Rather, it is designed to adapt to changes in hazard vulnerability, the capability of state agencies and participating stakeholders, and agreed upon modifications to goals and mitigation actions over time. As a result, the plan maintenance procedures described below are intended to reflect a certain level of flexibility, which enables members of the ICC to adapt, as needed, to changing conditions. The development of specific procedures also provides a sound and defensible means to collectively identify the conditions under which implementation decisions are made.

A. *MONITORING, EVALUATING AND UPDATING THE PLAN*

Monitoring of the plan is required to ensure that the goals of the State of South Carolina are kept current, to include monitoring which state mitigation efforts are being carried out and ensuring that the plan complies with state and federal requirements. The SCEMD Mitigation Staff is responsible for monitoring the plan. Generally speaking, the following principles guide the implementation of this plan:

1. The delineation of a uniform approach to hazard identification, vulnerability analysis, risk assessment, and mitigation planning.
2. The ICC will serve as the lead group guiding the state mitigation planning process, including the implementation of state-level programs.
3. The support of mitigation planning is linked to the risk posed to the state's communities, businesses, institutions and environmental resources.
4. The provision of coordinated, uniform, and consistent policies and practices tied to the technical, administrative and regulatory requirements associated with mitigation and post-disaster recovery and reconstruction.
5. The sharing of staff expertise, data and other resources, as practical, through inter-organizational consultation and cooperation.
6. The optimization of state agency programs that offer opportunities to enhance the disaster resistance of communities, businesses and institutions.
7. The vigorous pursuit of opportunities to gain financial, technical and other support for mitigation and post-disaster recovery and reconstruction activities.

As required under the Stafford Act, update reviews will occur at least every three (3) years. For future updates to the 2013 South Carolina State Hazard Mitigation Plan, the SCEMD Mitigation Staff with the coordination of the ICC will continue to review the plan on a quarterly basis and make modifications when deemed necessary. An annual review by the ICC will be conducted to ensure that the plan is being properly implemented and is achieving the objectives set forth in the plan. The ICC will also evaluate the nature and magnitude of hazard events and/or community development that has changed since the plan's implementation. In addition, the ICC will also ask state stakeholders for regular updates on the status of mitigation projects and programs found in the Mitigation Action Plan.

B. PROGRESS ASSESSMENT/REVIEW FOR MITIGATION GOALS OBJECTIVES AND MEASURES

In order for any program to remain effective, the goals and objectives of that program must be reviewed periodically. That review should address, as a minimum, the following issues:

1. Are the established goals and objectives realistic considering available funding, staffing, state/local capabilities, and the overall State Mitigation Strategy?
2. Has the State clearly explained the overall mitigation strategy to local governments?
3. Are proposed mitigation projects evaluated based on how they help the State and/or local government meet their overall mitigation goals and objectives?
4. How have approved mitigation projects complemented existing State and/or local government mitigation goals and objectives?
5. Have completed mitigation projects generated the anticipated cost avoidance or other disaster reduction result?

In addition to evaluating the mitigation goals, a thorough and realistic evaluation of the benefits of a mitigation project must occur. This process may be delayed until the area of the project is impacted by a disaster, as it is difficult to fully understand the benefits of a mitigation action until it is tested in a real-world event. The lack of realized benefits from a completed mitigation project may result in the disapproval or modification of similar projects in the future. At the same time, mitigation projects that have proven their worth may be repeated and prioritized in other areas of the State.

Based on the results of the assessment mentioned above, the State may need to adjust its goals, objectives, and measures to meet the current and future mitigation needs of the State and local governments. The ICC will be responsible for making any amendments to the State Mitigation Goals. Documentation of these changes will be tracked in ICC meeting minutes and updated in the subsequent plan update.

As requested, a formal mitigation status report will be prepared by SCEMD/ICC on an annual basis. With the 2013 update, all mitigation actions were placed in the South Carolina Mitigation Actions Tracking Database. This database places all actions in a format that is easily sorted. Actions can be quickly found based on hazard type, project, goal, etc. At a minimum, the report will address the following items:

1. Completed mitigation projects

a. Affected jurisdiction
b. Brief description of the project
c. Source of funding
d. Brief summary of any problem areas, with proposed solution
e. Brief summary of effectiveness (cost-avoidance) of project, if available

2. Mitigation projects in progress
   a. Affected jurisdiction
   b. Brief description of the project
   c. Source of funding
   d. Brief summary of project status
   e. Anticipated completion date

3. Pending (under review) mitigation projects
   a. Affected jurisdiction
   b. Brief description of the project
   c. Source of funding
   d. Brief summary of project status

Before any mitigation project is approved by SCEMD/ICC, it must comply with the following items as a minimum:

1. Complement the overall mitigation strategy of the State and applicable local government;
2. Suitable funding, to include the local match (if needed), must be available;
3. The project must be cost-effective. The updated FEMA benefit cost module is generally used to make this determination;
4. The project must be in compliance with all other federal, State, and local regulations and policies; and
5. The project must provide a benefit to the community at large.

It may be difficult to determine the actual cost avoidance and effectiveness of many mitigation projects during the development of the projects. Initially, the potential impact of these mitigation projects and initiatives can only be estimated. However, based on past experience with similar projects, SCEMD/ICC can make an educated determination as to the potential for success of the proposed mitigation project.

Following natural and/or man made hazardous events; SCEMD Mitigation Staff will query local officials to document how mitigation measures instituted in the affected areas lessened the amount of damages or loss of life that may have resulted from those events. Over the next three years, SCEMD will continue to develop standard operating procedures to enhance the opportunities to analyze successes.

C. POST DISASTER PROGRESS ASSESSMENT/REVIEW FOR GOALS, OBJECTIVES AND MEASURES

Findings and information obtained from the above-mentioned annual report and from information received immediately after a disaster will be incorporated into mitigation success stories to aid in the assessment of the current and future goals, objectives, and measures.

Evaluation of future disasters and their impact on a community is another means of evaluating the success of a mitigation project.

In 2007, SCEMD was in the process of implementing GIS and GPS technology to further document the mitigation project progress to further refine the monitoring of the projects of the program to improve the accuracy of future assessments. This technology was implemented for the 2010 and 2013 update and is illustrated by the following graphics in Figure 9.1 and 9.2.

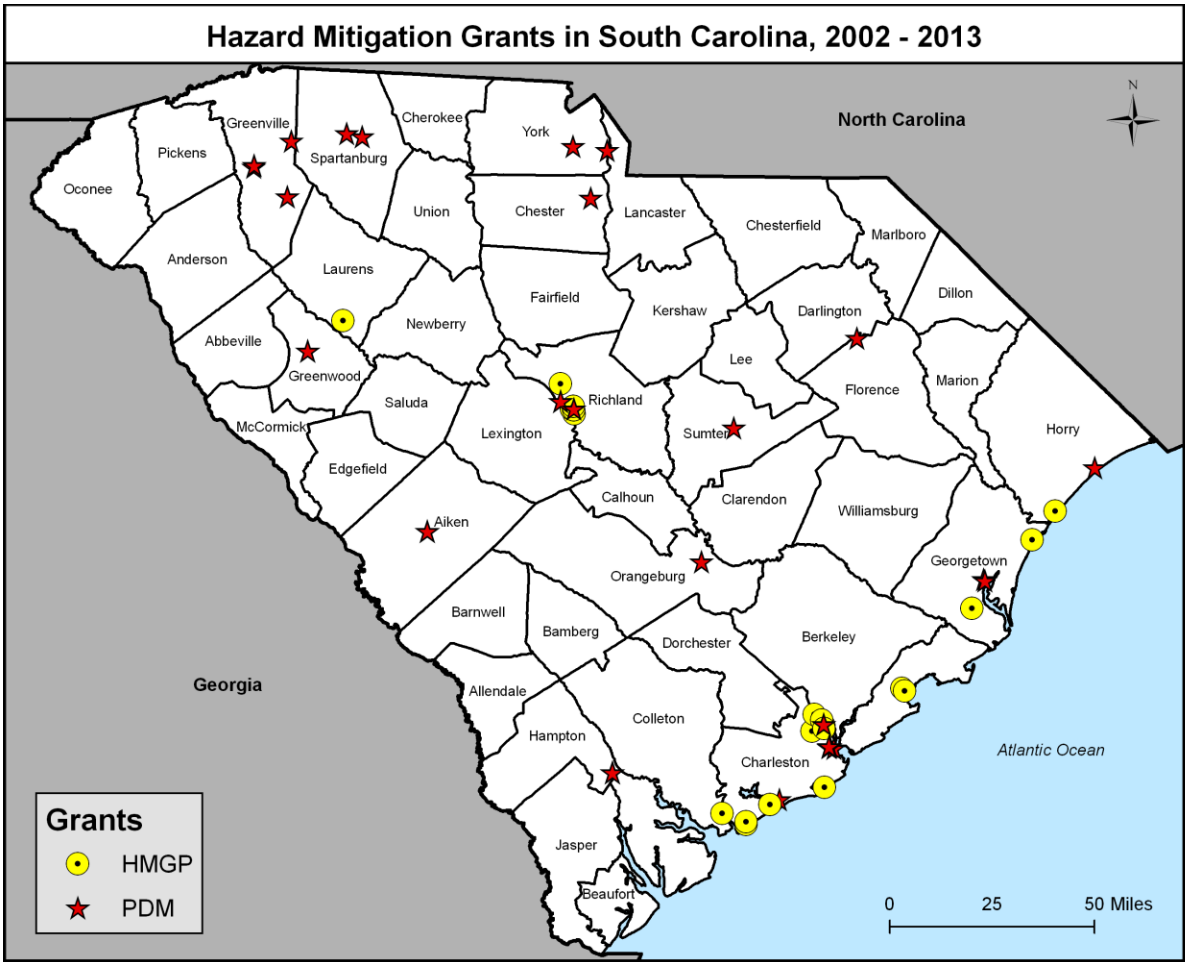


FIGURE 9.1—SOUTH CAROLINA MITIGATION GRANTS BY LOCATION

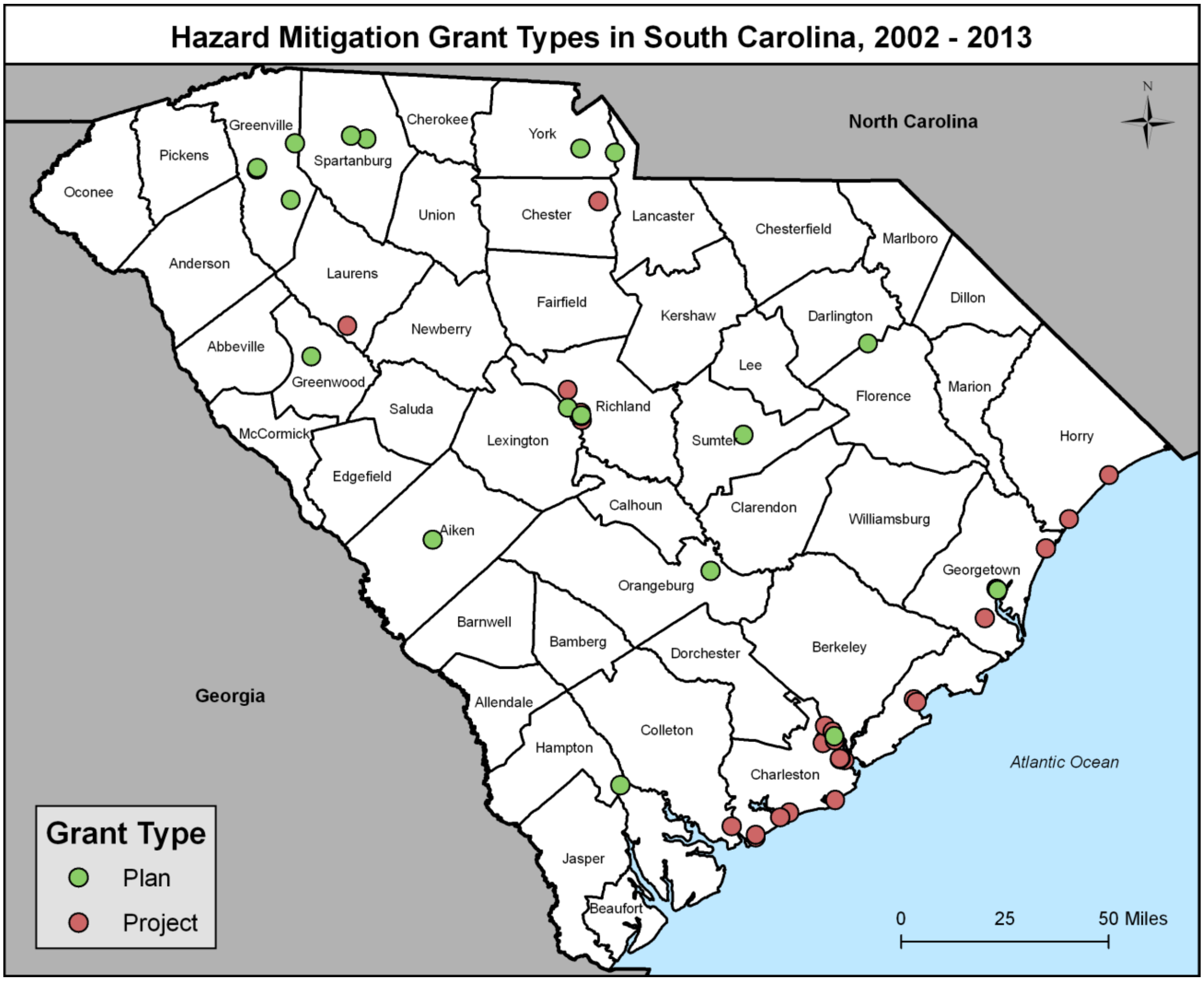


FIGURE 9.2—SOUTH CAROLINA MITIGATION GRANTS BY LOCATION

Note: Many of the planning grants were used to write regional mitigation plans. All Council of Governments (COG) in South Carolina received federal funding to write regional local hazard mitigation plans. Charleston County wrote their plan under the DMA 2000 requirements. The Berkeley-Charleston-Dorchester COG wrote a plan for only Berkeley and Dorchester counties. Points on the map represent the location of the sub-grantee agent, which is often the COG.

D. ANNUAL REPORTING PROCEDURES

The State Hazard Mitigation Plan shall be reviewed annually, as required by the SCEMD Mitigation Department or as situations dictate (i.e., following a disaster declaration). SCDNR may also review and update the plan as needed and as approved by the ICC to maintain adherence to planning requirements within the Flood Mitigation Assistance Program. Each year, the SCEMD Mitigation Staff will work with the ICC to assign responsibility for conducting this annual review to specific departments or individuals. Department officials or individuals assigned these duties will ensure the following:

1. Interagency Coordination Council members and other participating agencies will conduct an annual review and/or presentation on the implementation status of the plan. Over the past three years for the 2013 update, this annual review took place by means of the annual Mitigation Planning Committee (MPC) meeting. This review will include, at a minimum, a completed, printed version of the Mitigation Action Plan (MAP). Also during this review, participating agencies will be tasked with the update of agency specific mitigation actions.
2. The review will include an evaluation of the effectiveness and appropriateness of the mitigation actions proposed in the plan. There are several means to assess effectiveness.
3. Specific techniques include the use of the MAP to monitor the number and percentage of completed mitigation actions per established timelines and cost-effectiveness determinations of mitigation projects. In future plan updates, the ICC will consider the documentation of losses avoided for completed hazard mitigation projects.
4. The State Hazard Mitigation Plan is linked to existing planning practices and day-to-day activities of State agency officials whenever possible. Specific examples of on-going hazard mitigation programs and practices are described in the capability assessment.
5. The annual report will recommend, as appropriate, any required changes or amendments to the plan.

If the ICC determines that the recommendations warrant modification to the plan, the SHMO will initiate a plan amendment as described next.

E. EVALUATION AND ENHANCEMENT

Periodic revisions and updates of the plan are required to ensure that the goals and objectives for the State of South Carolina are kept current. This is particularly important as hazard vulnerability changes, mitigation actions are completed or goals and mitigation actions are modified or added. In addition, revisions may be necessary to ensure that the plan is in full compliance with changing Federal and State regulations. This portion of the plan outlines the procedures for completing such revisions and updates.

Following a disaster declaration, the plan may be revised to reflect lessons learned or to address specific circumstances arising from the disaster, including the documentation of losses avoided as a result of completed mitigation projects. The ICC will convene post-disaster to evaluate the current status of the plan and determine if modifications are necessary. Every three to five years (depending on federal requirements) for the State Plan update, the plan will be reviewed and enhanced to incorporate completed local hazard mitigation plans with emphasis placed on the integration of the local risk assessment findings and mitigation strategies.

If the ICC determines that the recommendations found in the post-disaster review warrant modification to the plan, the ICC may initiate a plan amendment as described below. The ICC may direct the SHMO to undertake a complete update of the plan if necessary. Plan enhancements will be coordinated with FEMA staff, as appropriate. Plan evaluation and enhancement procedures follow a schedule similar to that noted in Section 2, Planning Process:

1. The state will convene the ICC to review the findings of the local risk assessments and mitigation strategies;
2. The state will convene the ICC to evaluate the State Hazard Mitigation Plan post disaster, every three to five years as required by the Disaster Mitigation Act, and as deemed appropriate by the SCEMD Mitigation Staff;
3. The ICC will assess how local risk and mitigation actions compliment or conflict with the goals and actions of the State Hazard Mitigation Plan;
4. The State Hazard Mitigation Plan will be amended to integrate the findings of the risk assessments and support the recommended actions of local plans once they are completed and as they are updated over time, and as deemed appropriate by the ICC;
5. The ICC will convene following disasters, following local plan update schedules, or as appropriate, to re-evaluate new information made available by local governments regarding changes in risk or the adoption of new mitigation actions. These changes will be reviewed, and potential changes to the State Hazard Mitigation Plan will be considered.

The timeframe for the entire review and evaluation of the State Hazard Mitigation Plan will take place every three to five years. This timeframe for completion may vary based on recent disaster declarations or other factors beyond control of the SCEMD. The process is further described below:

1. Collecting and summarizing the local risk assessment findings and mitigation actions;
2. Collecting and summarizing state-level risk assessment findings and studies, new program initiatives, and proposed mitigation actions;
3. Convening the ICC, gathering their input, and writing up the results; and
4. Integrating the local data and mitigation actions and state-level analyses and program initiatives into the State Hazard Mitigation Plan.

F. UPDATING THE PLAN

An amendment/update to the plan should be initiated only by the ICC, either at its own initiative or upon the recommendation of the Director of SCEMD, SCDNR, the SHMO, or FEMA. Upon initiation of an amendment/update to the plan, SCEMD will forward information on the proposed amendment/update to all interested parties including, but not limited to, all ICC members, appropriate state agencies, the Director of SCEMD and appropriate FEMA staff. Input on the proposed plan amendments/updates will be sought for not less than a 45-day review and comment period.

At the end of the comment period, the proposed amendments/updates and all review comments will be forwarded to the SCEMD Director (or his/her designee) for consideration. The SCEMD Mitigation Staff will review the proposed amendments/updates along with the comments received from other parties, and submit a recommendation to the ICC within 60 days.

In determining whether to recommend approval or denial of a plan amendment/update request, the following factors will be considered:

1. There are errors or omissions made in the identification of issues or needs during the preparation of the plan;
2. New issues or needs have been identified which were not adequately addressed in the plan; and
3. There has been a change in information, data, or assumptions from those on which the plan was based.

Upon receiving the recommendation of the SCEMD Mitigation Staff, the ICC may hold a public hearing, depending on the nature of the plan amendment/update. The Council will review the recommendation (including the factors listed above) and any oral or written comments received at the public hearing. Following that review, the Council will take one of the following actions:

1. Adopt the proposed amendment/update as presented;
2. Adopt the proposed amendment/update with modifications;
3. Refer the amendment/update request back to the SCEMD Mitigation Staff for further consideration; or
4. Defer the amendment/update request for further consideration and/or hearing.

G. MONITORING PROJECT IMPLEMENTATION AND CLOSEOUT

The State of South Carolina will manage all projects and closeouts in accordance with federal requirements as stated in the Stafford Act, Biggert-Water Flood Insurance Reform Act of 2012, Title 44 of the Code of Federal Regulations, OMB Circulars A-21, A-87, A-102, A-110, A-122, A-133 and any other applicable requirements.

H. CHANGES FROM THE LAST PLAN

Because of FEMA requirements for plan updates, this section was reviewed and analyzed by the ICC as a result of the plan update completed in October 2013. As part of the update, the ICC reviewed the plan maintenance procedures in 2013 and made small revisions regarding semantics. Overall, it was determined that the system and methods identified in this section are still appropriate and no elements or processes need to be changed in order to continue to successfully monitor, evaluate and update the plan. Figure 9.2 was added to show how SCEMD tracks mitigation funding in the State through the use of GIS.

ACRONYMS

APA	Approval Pending Adoption
ADMIN PLAN	State Administrative Plan
BCA	Benefit Cost Analysis
BCR	Benefit Cost Ratio
BCEGS	Building Code Effectiveness Grading Schedule
BW-12	Biggert-Waters Flood Insurance Reform Act of 2012
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
COG	Council of Governments
CRS	Community Rating System
CTP	Cooperating Technical Partner
DMA 2000	Disaster Mitigation Act of 2000
DOB	Duplication of Benefits
DOT	Department of Transportation
EMAC	Emergency Management Assistance Compact
EMAP	Emergency Management Accreditation Program
EOP	Emergency Operations Plan
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
GAR	Governor's Authorized Representative
GIS	Geographic Information System
HAZUS-MH	Hazards U.S. Multi-Hazard
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HVRI	Hazard & Vulnerability Research Institute
ICC	Interagency Coordinating Committee

ISO	International Organization for Standardization
LHMP	Local Hazard Mitigation Plan
LLR	South Carolina Department of Labor, Licensing, and Regulation
MAP	Mitigation Action Plan
NFIP	National Flood Insurance Program
NWS	National Weather Service
OCRM	Office of Ocean and Coastal Resource Management
PDM	Pre-Disaster Mitigation
RFC	Repetitive Flood Claims
RFF	Request for Funds
SRL	Severe Repetitive Flood Loss
SCAHM	South Carolina Association of Hazard Mitigation
SCDOI	South Carolina Department of Insurance
SCDNR	South Carolina Department of Natural Resources
SCDHEC	South Carolina Department of Health & Environmental Control
SCEMD	South Carolina Emergency Management Division
SHMO	State Hazard Mitigation Officer
SHMP	State Hazard Mitigation Plan
SHPO	State Historic Preservation Officer
UHMA	Uniform Hazard Mitigation Assistance
USDA	United States Department of Agriculture

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[38] http://www.nssl.noaa.gov/primer/tstorm/tst_basics.html

[39] Weather and Climate p333

[40] Understanding Weather and Climate p335

[41] http://www.srh.noaa.gov/ama/?n=supercell

[42] http://w1.weather.gov/glossary/index.php?letter=m

[43] Edward Aguado and James E. Burt, *Understanding Weather and Climate 5th ed.* (NJ: Pearson Prentice Hall, 2010), p351.

[44] http://www.nssl.noaa.gov/primer/tornado/tor_basics.html

[45] http://www.noaawatch.gov/themes/flooding.php

[46] http://www.nws.noaa.gov/floodsafety/

[47]http://training.fema.gov/EMIWeb/edu/docs/fmc/Chapter%202%20-%20Types%20of%20Floods%20and%20Floodplains.pdf

[48] http://pacoletmemories.com/1903flood.pdf

[49] http://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13; http://www.fema.gov/policy-claim-statistics-flood-insurance/policy-claim-statistics-flood-insurance/policy-claim-13/loss (for flood insurance loss data)

[50] The National Flood Insurance Program (NFIP) definition of repetitive loss is, "any NFIP-insured property that, since 1978 and regardless of any change(s) of ownership during that period, has experienced: a) four or more paid flood losses; or b) two paid flood losses within a 10-year period that equal or exceed the current value of the insured property; or c) three or more paid losses that equal or exceed the current value of the insured property." For purposes of the Community Rating System the definition of repetitive loss is, "a property for which two or more NFIP losses of at least $1,000 each have been paid within any 10-year rolling period since 1978."

[51] http://firewise.msu.edu/wildfire_causes

[52] http://www.state.sc.us/forest/refwild.htm

[53] http://www.noaawatch.gov/themes/fire.php

[54] http://www.state.sc.us/forest/baninfo.htm

[55] http://www.state.sc.us/forest/fireimp.htm

[56] http://www.nws.noaa.gov/om/csd/graphics/content/outreach/brochures/FactSheet_Drought.pdf

[57] http://droughtmonitor.unl.edu/about.html

[58] http://www.wrh.noaa.gov/fgz/science/drought.php?wfo=fgz

[59] Kiuchi. M., 2002, Multiyear-Drought Impact on Hydrologic Conditions in South Carolina, Water Years 1998-2001, Masaaki Kiuchi, South Carolina Department of Natural Resources, 3 p. http://www.dnr.sc.gov/lwc/img/drought.pdf

[60] Harder, S.V., Gawne, C.E., Gellici, J.A., and Wachob, Andrew, 2012, Ground-water levels in South Carolina, 2006-2010: South Carolina Department of Natural Resources, Water Resources Report 50, 1 plate, 154 p. http://www.dnr.sc.gov/water/hydro/HydroPubs/pdf/Report_50_WL_Data.pdf

[61] http://www.weather.com/outlook/weather-news/news/articles/iwitness-hail-slideshow_2011-08-11

[62] http://www.nssl.noaa.gov/education/svrwx101/hail/

[63] Supercooled water is water in the liquid phase, but below its freezing point. It crystallizes when it comes in contact with some nuclei (19).

[64] *Understanding Weather and Climate,* p213

[65] http://w1.weather.gov/glossary/index.php?letter=s

[66] "Winter Storms A Preparedness Guide" (2001) US Department of Commerce, NOAA, NWS, ARC

[67] http://www.weather.com/encyclopedia/winter/types.html

[68] http://www.ready.gov/winter-weather

[69] http://www.weather.com/encyclopedia/winter/types.html

[70] http://www.weather.com/blog/weather/8_15036.html

[71] http://www.dnr.sc.gov/climate/sco/Publications/page_storm_reports.php "February 12-13 2010 Heavy Snow" Event Report. Malsick, March 12, 2010.

[72] http://www.scemd.org/index.php/department/response/contact-component

[73] http://bssa.geoscienceworld.org/content/83/5/1442.abstract

[74] http://scearthquakes.cofc.edu/SCEQ/SCEQ1886.html

[75] http://earthquake.usgs.gov/learn/glossary/?term=fault

[76] http://www.eoearth.org/article/Earthquake

[77] http://earthquake.usgs.gov/learn/glossary/?term=fault

[78] http://www.usgs.gov/faq/index.php?sid=54684&lang=en&action=artikel&cat=116&id=1736&artlang=en

[79] eoearth.org

[80] http://earthquake.usgs.gov/earthquakes/states/south_carolina/history.php

[81] http://www.dnr.sc.gov/geology/RecentEarthquakes.htm

[82] http://ga.water.usgs.gov/edu/sinkholes.html

[83] http://pubs.usgs.gov/fs/2007/3060/pdf/FS2007-3060.pdf

[84] http://landslides.usgs.gov/

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[88] http://tri.supportportal.com/link/portal/23002/23021/Article/23159/What-is-the-Toxics-Release-Inventory

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[98] (ready.gov, NOAA).

[99] http://news.cofc.edu/2011/03/11/earthquakes-tsunamis-and-south-carolina/

[100] http://www.tsunamiready.noaa.gov/